

SNR EXHIBIT 2

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**UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK**

IN RE: INTEREST RATE SWAPS ANTITRUST
LITIGATION

No. 16 MD 2704 (PAE)

This Document Relates To: All Class Actions

**REPORT OF DARRELL DUFFIE IN SUPPORT OF CLASS PLAINTIFFS'
MOTION FOR CLASS CERTIFICATION**

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I. QUESTIONS TO ADDRESS AND SUMMARY OF RESPONSES

1. In connection with an evaluation of the impact of the alleged conspiracy on members of the proposed class, I was asked to address the following questions.
2. When did interest rate swaps (IRS) become suitable for all-to-all trading?
3. Assuming there were no dealer-created obstacles, how quickly could the IRS market have transitioned to a market structure in which the majority of the volume traded on anonymous all-to-all platforms?
4. Assuming there were no dealer-created obstacles, what impact would the emergence of viable anonymous all-to-all trade platforms such as Javelin, trueEX, Tera, and Bloomberg have had on the structure of the IRS market? Similarly, what would have been the effect of the advent of anonymous all-to-all trade on existing platforms operated by inter-dealer brokers such as ICAP and Tradition?
5. What impact would the emergence of such anonymous all-to-all platforms have had on market behavior and market participants for (i) standardized IRS, (ii) less standard IRS and related OTC interest rate derivatives, and (iii) block trades?
6. My responses to these questions are summarized in the remainder of this Section. Sections III through VI provide supporting details and arguments.
7. Standard IRS became suitable for anonymous all-to-all trade before 2010. Indeed, by 2005 the necessary operational capabilities existed for all-to-all IRS trade venues and central clearing. IRS had also been sufficiently standardized by 2005 to allow this transition. Trade activity in standard “plain-vanilla” IRS was already substantial in advance of 2005, and would have been even greater had all-to-all anonymous trade actually been available. Central clearing of standardized IRS had begun by 2000, and by 2005 had already reached tens of trillions of dollars of outstanding notional.
8. Assuming there had been no dealer-created obstacles, a large fraction of trade in the IRS market could have made a rapid transition to anonymous all-to-all trade by 2010 or earlier, especially given the momentum for the reform of the OTC derivatives market that was created in the wake of the financial crisis. Trade platform operators would have set up new anonymous all-to-all trade facilities for the exchange of standard IRS. Anonymous all-to-all trade would have become active on existing inter-dealer broker platforms. If acting in their individual interests, some dealers would have reacted by offering market-making services on anonymous all-to-all platforms. Buy-side investors would have begun to send orders to these platforms. Once all-to-all trade platforms had begun to handle a non-trivial amount of trade volume, the majority of trade volume in standard IRS would likely have made the transition to anonymous all-to-all trade within months.
9. Assuming there had been no dealer-created obstacles, the emergence of viable anonymous all-to-all trade platforms such as those of Javelin, trueEX, Tera, and Bloomberg, and a transition to anonymous all-to-all trade on existing inter-dealer

platforms, would have had a significant impact on the structure of the IRS market. With the emergence of anonymous all-to-all trade, the price terms of trade offered to buy-side firms would have improved substantially, through increased competition among dealers and non-dealers to provide immediacy for buy-side trade demands. Trade volumes, market depth, and the breadth of participation in trade would all have increased. New buy-side firms would have entered the IRS market, encouraged by the lower trading costs associated with improved buy-side price terms, increased price transparency, and reduced operational complexity, delays, and costs. The fraction of trade intermediated by dealers, and the average dealer profit margin on each trade, would both have declined significantly. Non-dealers would have had, for the first time, the opportunity to provide liquidity to other market participants. Financial stability would have been improved through the increased use of central clearing and reduced reliance on dealers for the provision of liquidity, reducing the exposure of systemically important dealer banks to enormous swap portfolios. A greater range of cross-product trading strategies and risk-management methods would have become effective. Overall, the market would have become more efficient, transparent, and stable.

10. I have just summarized the impact on market structure and trade in standardized IRS of the emergence of anonymous all-to-all platforms. There would have been similar effects for other standard OTC interest-rate derivatives that were also ready for a transition to anonymous all-to-all trade, including some actively traded types of FRAs, OIS, and single-currency basis swaps. As for non-standard or less standard IRS and related products, some trades in these products would have been substituted with trades of standardized IRS, FRAs, basis swaps, and OIS on anonymous all-to-all platforms, given the benefits of anonymous all-to-all trade that I have described in the previous paragraph. For the remaining trade in less-standard or non-standard products, and also for block trades of standardized interest-rate derivatives that are conducted away from all-to-all venues, the price terms of trade offered by dealers to buy-side firms would have been more competitive, and thus more advantageous to the buy-side. This is so because of (i) the heightened price transparency of related standard products available on all-to-all trade venues, which would have improved comparison-pricing information for less standard products, and (ii) the discipline on dealers' price quotes associated with the recognition that buy-side firms could, if offered sufficiently unattractive prices, substitute with standard products available on all-to-all platforms.
11. All or nearly all buy-side firms would have benefited from the emergence of viable anonymous all-to-all trade. This is so because of the effects that I have just described on market structure and trade in both standard IRS and other interest-rate derivatives. All market participants would have received more competitive price terms, thus lower execution costs, for trades that they chose to make on anonymous all-to-all platforms, due to the associated increases in price transparency and competition for their orders. Many buy-side firms would also have benefited from their ability to provide liquidity to other firms trading on these platforms, and no buy-side firms would have been harmed by the existence of this option to act as a provider of liquidity to others. All firms trading on these platforms would have benefited from reduced operational complexity and costs, and reduced trade delays associated with higher trade volumes and faster trade execution methods. Large buy-side firms would have benefited from the option to execute some

portions of their block-size orders on all-to-all platforms at more competitive price terms. They would have retained the option to execute some of their block-size trades (or some portions of these trades) using other trade protocols. When facing dealers away from all-to-all trade platforms, a buy-side firm's option to substitute some of its trade with an order on an all-to-all trade platform would have better disciplined dealer price quotes, thus further lowering execution costs. Buy-side firms trading interest-rate derivatives that were not available on anonymous all-to-all trade platforms, because they were not sufficiently standardized or actively traded, would have benefited from the option to substitute with related interest-rate derivatives available on all-to-all platforms. Buy-side firms trading less standard financial instruments would also have benefited from the increased discipline on dealer quotes associated with heightened price transparency and recognition by dealers of buy-side options to substitute with similar products available on all-to-all platforms.

II. QUALIFICATIONS

12. I am the Dean Witter Distinguished Professor of Finance at the Graduate School of Business, Stanford University, and Professor by Courtesy, Department of Economics, Stanford University. A substantial focus of my research, teaching, and policy-related work is the market for derivatives, including IRS, and more generally how alternative market structures and trade protocols affect financial markets.
13. In addition to a wide range of consulting work performed for regulators, governments, and various types of financial market participants, I have written policy reports, books, and many peer-reviewed research papers that address over-the-counter (OTC) markets, IRS, trade protocols, OTC price transparency, swap counterparty risk, and the central clearing of swaps. My most recent books are: *Dark Markets: Asset Pricing and Information Transmission in Over-the-Counter Markets* (Princeton University Press, 2012), *Measuring Corporate Default Risk* (Oxford University Press, 2011) and *How Big Banks Fail* (Princeton University Press, 2010). I have been a member of the editorial boards of a number of leading peer-reviewed academic research journals, and have frequently provided policy advice to regulators on the structure of OTC markets.
14. Among other appointments and activities, I served on the Financial Advisory Roundtable¹ of the Federal Reserve Bank of New York from 2007 to 2015. The Federal Reserve Bank of Chicago and I organize an annual or bi-annual series of symposia on OTC Derivatives and Central Clearing. The eighth of this series of major symposia will be held at the Federal Reserve Bank of Chicago in April 2019. The Federal Reserve Bank of Chicago and I set up programs and expert speakers for these symposia that cover a range of issues involving swap market structure, including access of buy-side market

¹ The Federal Reserve Bank of New York describes the Financial Advisory Roundtable as “[a] group of distinguished economists, risk management professionals and other experts in the financial markets meet twice a year with the president of the New York Fed to discuss financial stability issues and present their views on financial policy.” Financial Advisory Roundtable, <https://www.newyorkfed.org/aboutthefed/far.html>.

participants. The speakers and attendees that we invite include most of the world's leading swap-market participants and regulators.

15. I am an advisor to the Shanghai Clearing House, the central counterparty for China's interest-rate swap market. From 2015-2018, I served as an expert² for the Government of Canada in a matter before the Supreme Court of Canada concerning the constitutionality of the Capital Markets Stability Act, legislation covering the authority of Canada's federal government in financial markets, including, among other issues, central counterparties and interest-rate benchmarks. I have given U.S. Congressional testimony on swap markets before the Senate Banking Committee and the House Financial Services Committee.
16. From 2014-2017, I chaired the Market Participants Group on Reforming Interest Rate Benchmarks, charged by the Financial Stability Board (FSB) with recommending reforms to LIBOR, EURIBOR, and other interest-rate benchmarks used in OTC and exchange-traded derivatives markets, among other financial markets.³ The FSB is the international body of financial regulators that monitors and makes recommendations about the financial system. The FSB's member institutions include all of the world's leading developed-market central banks and securities markets regulators. The members of the Markets Participants Group included executives of many the world's largest swap dealers, buy-side firms, and other participants in the market for interest-rate swaps. Financial market regulators in the U.S., U.K., Switzerland, and Japan have begun implementing some of the key recommendations of our 700-page report, including the replacement of LIBOR with new reference rates.
17. I frequently give presentations to regulators on financial market policy. For example, in 2016, I gave presentations⁴ on market structure and related policy issues at the annual "Jackson Hole" meeting of the U.S. Federal Reserve and at the analogous annual "Sintra" meeting of the European Central Bank. As a more recent example, in January 2019, at the

² Duffie, Darrell, "Systemic Risk in Financial Systems and Capital Markets in Relationship with the Proposed Draft Capital Markets Stability Act," Expert Report submitted to Canada's Department of Justice, May 2016.

³ Market Participants Group on Reforming Interest Rate Benchmarks, Final Report, March 2014, Executive Summary and Appendix B, http://www.fsb.org/wp-content/uploads/r_140722b.pdf?page_moved=1.

⁴ Duffie, Darrell, and Arvind Krishnamurthy, "Passthrough Efficiency in the Fed's New Monetary Policy Setting," in Richard A. Babson, editor, *Designing Resilient Monetary Policy Frameworks for the Future, A Symposium Sponsored by the Federal Reserve Bank of Kansas City*, Jackson Hole, Wyoming, August 25-27, 2016, Federal Reserve Bank of Kansas City, pp. 21-102; Duffie, Darrell "Financial Regulatory Reform After the Crisis: An Assessment," *Management Science*, vol. 64 (2018), pp. 4471-4965, presented at ECB Forum on Central Banking, Sintra, Portugal, June, 2016 (Presentation slides - <https://www.darrellduffie.com/uploads/policy/DuffieSintraSlidesJune2016.pdf>; Presentation video - https://www.youtube.com/watch?v=vDWGBevLdSc&feature=youtu.be&list=PLnVAEZuF9FZmThVnNRoOuGU7d5pX4_TpV beginning at minute 5:00).

Bank for International Settlements, I gave a presentation to regulators at a meeting of the Financial Stability Board on the structure of the OTC derivatives markets, with a focus on swap central counterparties and on the fragmentation of trade across trade venues.

18. I serve or have recently served as an advisor or member of scientific and industry organizations covering issues of concern to financial markets, including swap markets. Among these organizations are American Finance Association, VoxChina, Global Risk Institute, P.R.I.M.E. Finance Foundation (a panel of recognized international market experts in finance), Squam Lake Group, Asian Bureau of Finance and Economics Research, and World Economic Forum (Global Agenda Council on the Global Financial System and Steering Committee of The Role of Financial Services in Society).
19. I was elected the 2009 President of the American Finance Association, the leading U.S. and international academic organization of financial economists. I served on the Board of Directors of Moody's Corporation from 2008 to 2018. I am a member of the board of directors of TNB Inc., which plans to offer narrow banking services to large U.S. depositors. I have been appointed a director of the Dimensional Funds, effective March 2019. I am a Research Associate of the National Bureau of Economic Research and a Fellow of the American Academy of Arts and Sciences.
20. My CV, which includes additional relevant qualifications, is attached as Appendix A.

III. MANY IRS PRODUCTS WERE SUITABLE FOR ALL-TO-ALL ANONYMOUS TRADING BY 2010

21. In the remainder of this report, "buy-side" refers, as an adjective or a noun, to non-dealer participants in the market for interest rate swaps (IRS) and other financial products.
22. Prior to the financial crisis of 2007-2009, the majority of buy-side IRS and other OTC derivatives were bilaterally traded, by voice.⁵ That is, a buy-side customer of a dealer would request quotes from dealers, one dealer at a time. The customer had the option to reject a dealer's quotes and to contact another dealer for quotes. The market was opaque—buy-side investors had little information on prices available from other dealers. Later, I will describe the adverse impacts of bilateral-only trade on buy-side price terms, related trading costs, market efficiency, and financial stability.
23. Trade of some standardized IRS on Swap Execution Facilities (SEFs) was mandated by CFTC regulations implementing Section 5h of the Commodity Exchange Act, in Section 733 of the Dodd-Frank Wall Street Reform and Consumer Protection Act ("Dodd-Frank

⁵ Marcus, Dan, "CLOB Execution – the New Norm?," TraditionSEF, August 20, 2015, <http://www.traditionsef.com/news/press-releases/clob-execution-the-new-norm/>.

Act”). A goal of the Dodd-Frank Act is to promote the trading of swaps on SEFs and to promote pre-trade price transparency in the swaps market.⁶

24. Two types of SEF trading protocols meet CFTC regulations that implemented the Dodd-Frank Act, request for quote (RFQ) and order matching on a central limit order book (CLOB).
25. In most common practice, RFQ trade is based on a customer-to-dealer protocol, by which a buy-side firm requests price quotes simultaneously from multiple dealers on a given SEF. The customer then has the option to select from these quotes.
26. On an active anonymous CLOB SEF, a buy-side firm can engage in “all-to-all” anonymous trade competition. That is, participating dealers and non-dealers can place anonymous bids and offers on the CLOB, and can have their own orders anonymously executed against the bids and offers of all other participants. Trades are consolidated and matched with price and time priority.⁷ This is the essence of centralized exchange trade that is commonly found in the markets for publicly issued equities and exchange-traded options and futures.⁸
27. Relative to bilateral trade, customer-to-dealer RFQ trade generates greater competition among dealers for buy-side trades, because this protocol forces participating dealers to quote prices in direct competition with each other. Bilateral trade, on the other hand, gives an individual dealer a temporary monopoly, which affords the dealer an opportunity to take advantage of its customer’s weak outside option to break off a trade negotiation and seek quotes from another dealer, at some cost and delay. The adverse impact of this weak outside option on the price terms eventually achieved by the buy-side firm is captured in research by Professor Haoxiang Zhu⁹ and in my research with Professors Piotr Dworczak and Haoxiang Zhu.¹⁰ An alternative dealer’s potential price terms are uncertain to the customer. Thus, relative to bilateral trade, customer-to-dealer RFQ trade improves buy-side price terms, lowers other trade costs, and improves market efficiency.
28. Relative to anonymous all-to-all CLOB trade, however, customer-to-dealer RFQ trade involves less competition, with worse price terms and higher trading costs for non-

⁶ Swaps Execution Facilities (SEFs), U.S. Commodity Futures Trading Commission, <https://www.cftc.gov/IndustryOversight/TradingOrganizations/SEF2/index.htm>.

⁷ 77 Fed. Reg. 21,278, April 9, 2012.

⁸ See, for example, Glosten, Lawrence R., “Is the Electronic Open Limit Order Book Inevitable?,” *Journal of Finance*, vol. 49, no. 4 (1994), pp. 1127-1161.

⁹ Zhu, Haoxiang, “Finding a Good Price in Opaque Over-the-Counter Markets,” *Review of Financial Studies*, vol. 25 (2012), 1255-1285.

¹⁰ Duffie, Darrell, Piotr Dworczak, and Haoxiang Zhu, “Benchmarks in Search Markets,” *Journal of Finance*, vol. 72 (2017), 1983-2084.

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- dealers.¹¹ At a customer-to-dealer RFQ trade platform, competition among quote providers is limited to a subset of dealers, and there is no competition from non-dealers. Anonymous all-to-all CLOB trade, on the other hand, involves unrestricted competition among quote-providing dealers and non-dealers.
29. Beyond the key benefit of anonymous all-to-all trade relative to customer-to-dealer RFQ trade, of giving buy-side firms better expected price terms, anonymous all-to-all trade also gives buy-side firms the opportunity to earn additional profits by providing bids and offers to other market participants.
 30. A SEF trade protocol known as “all-to-all RFQ” allows buy-side firms to provide price quotes on an RFQ platform in response to requests for quotes by others. [REDACTED]¹² [REDACTED]. Consistent with the incentives of dealers to block all-to-all trade, as I shall explain, neither all-to-all CLOB nor all-to-all RFQ trade protocols ever achieved a non-trivial share of IRS trade volume.
 31. Whenever I discuss “all-to-all” trade in this report, unless I indicate otherwise, I am referring to all forms of all-to-all trade, including all-to-all CLOB trade and all-to-all RFQ trade. Because customer-to-dealer RFQ trade is far more common in practice than all-to-all RFQ trade, whenever I refer to “RFQ trade” without a qualification, I am referring to customer-to-dealer RFQ trade.
 32. When a market participant has an urgent demand to trade, some other market participant, a “provider of immediacy,” may be able to quickly meet that demand in return for a price concession. The price concession is reflected in the price terms of the trade, including the bid-offer spread and any additional price concession for larger trade sizes. The provision of immediacy is a form of intermediation that is also known as the provision of “liquidity.” When done on a continuing basis as a business practice, the provision of immediacy is known as “market making.”
 33. In practice, dealers are the only providers of immediacy for bilateral and RFQ trade. With all-to-all trade, however, dealers and some buy-side firms can compete for the opportunity to provide immediacy, and thus garner profits from the associated price concessions. This competition for trade and disintermediation of dealers would lead to a reduction in revenues and profits for dealers.
 34. Consistent with the incentives of dealers to avoid this additional competition and disintermediation, an August 2010 [REDACTED] “ [REDACTED] ” presentation¹³ [REDACTED], “ [REDACTED] ” [REDACTED]

¹¹ See, for example, Theissen, Erik “Market Structure, Informational Efficiency and Liquidity: An Experimental Comparison of Auction and Dealer Markets,” *Journal of Financial Markets*, vol. 3, no. 4 (2000), pp. 333-363.

¹² [REDACTED] and [REDACTED].

¹³ [REDACTED], at ‘503.

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” and “ ”’s presentation states that (“ ”) “ ” (“ ”) “ ”

35. In summary, with all-to-all trade, a buy-side firm can benefit both from higher competition for its trade demands, implying better price terms, and also from the opportunity to act as a provider of immediacy to others. Dealers, on the other hand, can suffer from the introduction of all-to-all trade through a reduction of the profit margin on each trade caused by greater competition for the provision of immediacy, and also from losing market share, through disintermediation by some buy-side firms.
36. Later in my report, I will outline other buy-side advantages of anonymous all-to-all trade.
37. The buy-side benefits of migration to anonymous all-to-all trade that I describe in this report also apply to small dealers, with respect to the trades that they conduct with larger dealers in the absence of anonymous all-to-all trade. This is so because small dealers, on average, seek liquidity from large dealers when using bilateral or RFQ protocols. On any of these trades, small dealers would obtain better prices at anonymous all-to-all trade platforms, because of the same economics involving competition and price transparency that I describe in this report for buy-side trades with dealers. Small dealers would also benefit from increased opportunities to profit from the provision of liquidity on anonymous all-to-all trade platforms, and from lower operational costs. Even though a migration of trade to anonymous all-to-all trade platforms could partially disintermediate some smaller dealers, this effect would be much smaller than for large dealers, who have handled the vast majority of intermediation of OTC interest-rate derivatives, and smaller dealers would nonetheless receive the benefits that I described above.
38. In contrast to the transition to anonymous all-to-all trading that would be expected given the (i) market conditions that I have described, (ii) the tailwind of regulatory reform, and (iii) the incentives of individual market participants, this transition has not happened.

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39. Such a transition was operationally feasible and would have benefited all, or nearly all, buy-side market participants.

A. General Criteria for All-to-All Anonymous Trading

40. A basic requirement for all-to-all trade is product standardization. A highly customized product, one whose terms are exotic, difficult to interpret, or tailored to a small subset of

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individual market participants, might not be sufficiently popular to justify the fixed costs of setting up exchange trading, and is not amenable to straight-through “back-office” processing and central clearing, which rely on standardization.

41. An additional criterion for transition to all-to-all trade is the potential for sufficient trade activity. Relevant indicia of trade activity are (i) total volume of trade, (ii) breadth of participation in trade across market participants, and (iii) frequency of trade demands.
42. Although sufficient levels of these indicia of trade activity need not be in place at the inception of all-to-all trade, there must be a sufficiently high expectation of eventual trade volume, and thus revenues for the trade platform operator from trade execution fees and related services such as access to transaction data, to justify the costs to the platform operator of setting up and maintaining the necessary trading facilities. With sufficiently low trade activity, a platform operator may be unable to recoup its fixed costs and earn a sufficient return on its capital.
43. Higher trade activity implies a greater opportunity for buy-side firms to trade directly with each other, without a need to rely exclusively on dealers for the provision of immediacy. With low trade activity levels, buy-side firms are relatively less likely to be available to provide immediacy to other buy-side firms, and the relative advantage of all-to-all trade declines.
44. All-to-all anonymous trade typically relies on the existence of a central counterparty (CCP) to “clear” trades, in effect guaranteeing the performance of the traded contracts. On each trade, a CCP, also known as a “clearinghouse,” becomes the seller to the original buyer, and the buyer to the original seller. In this way, the original buyer and seller are insulated from each other’s default (failure to perform on their contracted payments). This is especially important for swaps because of the long-term counterparty credit exposures of swaps.
45. If, for example, the original buyer fails to make a contractually stipulated payment, the CCP steps in to make the required payment to the original seller. In order to have the funds on hand necessary to offer this effective performance guarantee, the CCP requires participating firms to post margin collateral at the CCP. Some of these market participants are also required to contribute capital to the CCPs’ default guarantee fund, which is available to cover default losses that exceed a defaulting firm’s posted margin.
46. A CCP also makes anonymous trade feasible. Buyers and sellers do not need to know each other’s identities because they will hold contracts with the CCP, not with each other.
47. Increases in trade activity make central clearing more feasible and less costly. Higher volumes and frequency of trade improve price transparency, which is important for determining safe (but not prohibitively high) CCP margin levels. More broadly-based trade also increases the ability of the CCP to net long positions against short positions. Increasing the breadth of participation thus allows the CCP to safely reduce the size of the default guarantee fund that is necessary to cover a given volume of trade. A large default guarantee fund, per unit of total trade volume, is more costly for participants to

maintain. The CCP operator is also expected to commit some of its own capital to cover losses that are not covered by margin and the default guarantee fund. Again, a high volume of cleared trades reduces the amount of CCP capital required per unit of trade activity. A larger volume of trade also allows a CCP to more easily cover its fixed operating costs with clearing fees. Altogether, CCPs benefit from substantial economies of scale and scope involving total volume, breadth of participation, and product coverage.

48. Low trade activity implies that large trade demands may significantly exceed the quantities available on a CLOB at the most attractive posted prices. This raises trade costs.
49. For example, suppose that a CLOB has relatively few, and only small, posted orders to sell. A large new arriving order to buy will in this case be only partially filled at the best (lowest available) offer price. The buyer will then suffer from larger and larger price concessions as the buy order “travels up” the limit order book to successively higher offer prices until the entire order size is executed. The buyer’s alternative is to submit only a small portion of the desired trade size, and to wait for the order book to be refreshed over time with the arrival of more sellers. This “order shredding” strategy implies a costly delay in the execution of the entire desired trade,¹⁵ and increases the risk to the buyer that market prices will go up before the entire order is executed. A seller faces analogous costs and risks associated with thin trading activity.
50. If the set of market participants competing to profit from the provision of immediacy is larger, and if the number, size, and frequency of orders from investors are higher, then the limit order book is correspondingly “deeper.” In that case, a firm submitting a large buy order can expect the order to be executed at an average price that relatively closer to the best bid prices, and to be executed more quickly. Likewise, a large sell order can then expect to be served at prices relatively closer to the best offer prices.
51. Thus, higher trade activity implies lower expected trade execution and delay costs, which encourages even more trade activity, causing yet lower execution costs, and so on in a virtuous feedback loop. In this manner, if there is sufficient potential trade activity, the introduction of all-to-all trade can generate, after some initializing period of growth in activity, very substantial increases in trade activity and thus reductions in buy-side trade execution costs relative to bilateral or RFQ trade, which have limited opportunities to benefit from the same virtuous feedback effect. In the next section, I will give some historical examples of the big beneficial impacts of the introduction, modernization, or expansion of exchange trading on trade volumes and trade execution costs.
52. In short, when judging whether all-to-all trade is viable, it is well supported that the introduction of all-to-all trade will itself generate substantial increases in trade activity. As I have emphasized, pre-existing levels of trade activity are only imperfect signals of the much higher potential level of trade volumes that can be achieved after the

¹⁵ See Antill, Samuel and Darrell Duffie, “Augmenting Markets with Mechanisms,” Working paper, Graduate School of Business, Stanford University, May, 2018; and Duffie, Darrell and Haoxiang Zhu, “Size Discovery,” *Review of Financial Studies*, vol. 30 (2017), pp. 1095-1150.

introduction of all-to-all trade. Trade platform operators, if unimpeded by others, make rational decisions to introduce all-to-all trade, even if there is essentially no pre-existing trade at all.

53. For example, the Chicago Mercantile Exchange (CME) recently introduced all-to-all trade in futures contracts that emulate 30-day and 90-day overnight-index swaps (OIS) whose underlying benchmark interest rate is the recently introduced Secured Overnight Financing Rate (SOFR). This introduction of exchange trade occurred despite the almost total absence of prior over-the-counter trade in OIS based on SOFR. The CME incurred substantial fixed costs to introduce SOFR futures, speculating that exchange trade would later become sufficiently active to overcome those fixed costs with exchange trading fees and fees for ancillary services, such as data access. Since inception, the volume of trade in CME SOFR futures contracts has indeed grown steadily. As shown in the figure below, average daily volume has climbed steadily from about 2,000 contracts in the month of introduction, May 2018, to about 18,400 contracts in January 2019.¹⁶ The number of market participants trading CME SOFR futures nearly doubled from 60 participants in May 2018 to over 105 participants in January 2019.¹⁷ The CME stated:¹⁸ “While it took 120 trading days to reach the first 500K contracts, it took just 38 days for the second 500K as deepening liquidity attracted greater institutional flow into the market.”
54. Although the enormous volume of IRS trade was spread out over many specific types of IRS, distinguished by tenor, currency, and other terms, a substantial amount of trade was in “benchmark” types, which were standardized with respect to inception date (“spot starting”), major currency, maturity (integer years, especially 2, 3, 5, 10, and 30), underlying floating rate (for instance 3-month US dollar LIBOR), and coupon payment frequencies.¹⁹ For benchmark IRS, in the years leading up to 2010, there was no need for trade platform operators to speculate much about whether there would be sufficient trade activity to justify the costs and risks of setting up all-to-all trade. Trade activity in benchmark IRS in the bilateral market had already reached high levels, easily justifying all-to-all IRS trade, even by 2007.

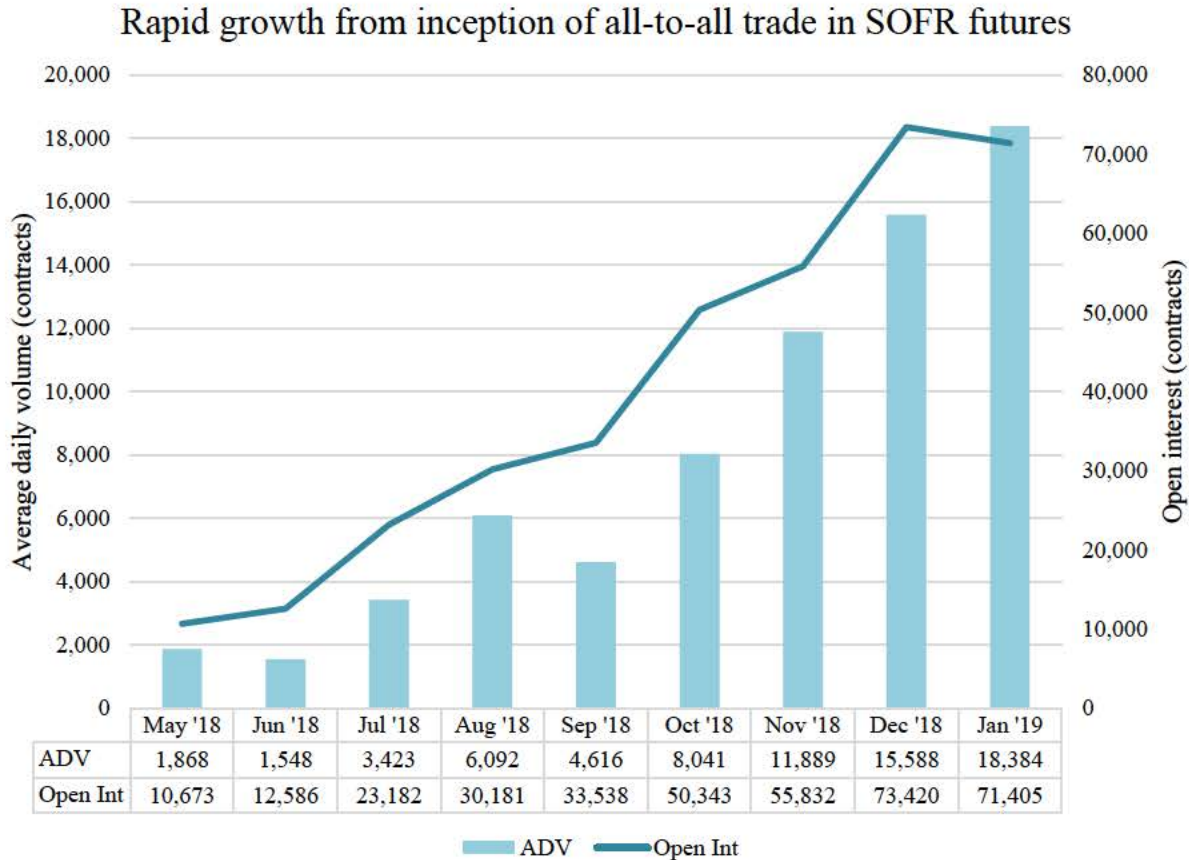
¹⁶ “SOFR Sets Record Pace for Short-Term Interest Rate (STIR) Futures Launch,” CME Group, June Rates Recap, <https://www.cmegroup.com/education/rates-recap/2018-06-rates-recap.html>; “Strong Liquidity in 2-Year Note Futures Following Tick Reduction,” CME Group, February Rates Recap, <https://www.cmegroup.com/education/rates-recap/2019-02-rates-recap.html>.

¹⁷ “SOFR Sets Record Pace for Short-Term Interest Rate (STIR) Futures Launch,” CME Group, June Rates Recap, <https://www.cmegroup.com/education/rates-recap/2018-06-rates-recap.html>; “Strong Liquidity in 2-Year Note Futures Following Tick Reduction,” CME Group, February Rates Recap, <https://www.cmegroup.com/education/rates-recap/2019-02-rates-recap.html>.

¹⁸ “Increase in Buyside Participation and Liquidity Result in Third Consecutive Record Year,” CME Group, January Rates Recap, <https://www.cmegroup.com/education/rates-recap/2019-01-rates-recap.html>.

¹⁹ See, for example, Fleming, Michael, John Jackson, Ada Li, Asani Sarkar, and Patricia Zobel, “An Analysis of OTC Interest Rate Derivative Transactions: Implications for Public Reporting,” Federal Reserve Bank of New York Staff Reports, Staff Report No. 557 (March 2012; revised October 2012), https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr557.pdf.

55. The 2007 Triennial Central Bank Survey conducted by the Bank for International Settlements (BIS) reported that OTC interest-rate derivatives trade volumes of over \$500 billion dollars per day in the U.S. alone, of which the majority were standard products.²⁰ The BIS reported that the total outstanding notional amount of US dollar IRS in the first half of 2008 was in excess of \$100 trillion.²¹ When including IRS in all major currencies, the BIS reports that the total outstanding notional amount exceeded \$350 trillion.



56. With the advent of anonymous all-to-all trade in benchmark IRS, market participants would have followed their incentives by substituting a significant amount of trade in off-benchmark types with trade in benchmark swap types in order to reap the benefits that I have described of anonymous all-to-all trade. Anonymous all-to-all trade would have triggered big increases in volumes, leading to the viability of all-to-all trade in additional benchmark types, just as has happened in historical examples of migration of trade onto exchanges.

²⁰ “Foreign Exchange and Derivatives Market Activity,” Triennial Central Bank Survey, Bank for International Statistics, December 2007, Table C.3, p. 17, <https://www.bis.org/publ/rpfx07t.pdf>.

²¹ “OTC Derivatives Market Activity in the First Half of 2008,” Monetary and Economic Department, Bank for International Statistics, Graph 2, p. 2, https://www.bis.org/publ/otc_hy0811.pdf.

57. For less actively traded OTC interest-rate derivatives, trade platform operators would have needed to base their decisions regarding the viability of all-to-all trade by conjecturing the impact of the introduction of all-to-all trade on the expected future path of increases in trade volumes.
58. A standardized financial product that is already somewhat actively traded on a SEF or another electronic trading platform (including inter-dealer electronic trading platforms), or that is traded bilaterally and can feasibly be centrally cleared, is typically ready for all-to-all trading. The same conclusion applies if the product is not already standardized but could be standardized without changing its important risk and cash-flow properties. For example, for the purposes of setting up all-to-all trade, simple fixed-for-floating IRS without benchmark maturities could in many cases be reasonably substituted with benchmark maturities at no great cost to the user with respect to desired product properties, including risk characteristics. Such a substitution would come with the substantial pricing and other benefits of anonymous all-to-all trade that I have described. Anonymous all-to-all trade can also be facilitated by substitution into IRS having quarterly maturity dates, as standardized by ISDA.²²
59. A continuously operating CLOB is not the only effective trading protocol for anonymous all-to-all trade. A wide variety of standardized IRS were suitable for central clearing, but potentially not sufficiently actively traded to be economically viable for trade on continuously operating CLOBs. Many of the less actively traded IRS could be effectively traded with other forms of anonymous all-to-all protocols, such as all-to-all RFQ, or all-to-all versions of session-based batch double auctions.²³
60. Platform operators are rational profit-maximizing firms and are generally knowledgeable about the markets in which they operate. If no impediments are placed in the way of their product listing and trade-protocol decisions, they have natural incentives to introduce anonymous all-to-all trade in products that they believe are sufficiently standardized and that can become sufficiently actively traded.

B. Historical Examples of Benefits to the Buy-Side from All-to-All Trading

61. All financial products that are currently traded on exchanges began their lives in the OTC market. Once these products were sufficiently standardized and frequently traded, exchange operators found that they could earn profits by offering exchange trading services, from trade execution fees and from the sale of transactions data. Because exchange trading improves price competition and transparency, and reduces legal and operational hurdles to participation by buy-side investors, exchange trading also broadens the set of active market participants. Because buy-side trading costs are usually lower on an exchange than when trading over the counter, the introduction of exchange trading

²² For example, see “ISDA Publishes Market Agreed Coupon Confirmation for Interest Rate Swaps,” ISDA News Release, April 24, 2013, <https://www.isda.org/a/koiDE/isda-publishes-market-agreed-coupon-confirmation.pdf>.

²³ For an example, see FIX Trading Global Fixed Income Committee, “Best Practices for Trading Fixed Income Instruments: CDS & IRS,” vol. 4 – Central Order Book Workflows, Version 4.0, May 8, 2014.

raises trade volumes and broadens participation, which further lowers trading costs through increased competition for trade, and so on, with a virtuous feedback effect.

62. When a new product is first listed on an exchange for trade, the exchange operator often subsidizes initial trading activity in order to promote the growth of trade volumes to profitable levels. For example, in February 1999, Eurex announced²⁴ that it was “waiving transaction fees for trading in Euribor derivatives (one-month and three-month Euribor futures as well as the option on these futures) until the end of the year. The exchange is thus extending by another nine months the fee waiver that has applied since the product launch in mid-September and was originally limited until the middle of March.” In the fall of 2004 CME announced²⁵ that it would offer a nine-month fee waiver to GLOBEX customers for its E-mini S&P 500 options on futures. CME stated that its goal was “to help generate further liquidity and attract new customer participation in this growing electronic market.” In 1988, LIFFE launched a trading platform competing with DTB for trade in German government bond futures. In 1991, in an attempt to win back some of its lost share to LIFFE, DTB lowered its margin requirements and temporarily suspended exchange fees on Bund futures.²⁶ In mid-2015, NASDAQ, disclosed plans to launch an energy futures exchange. To attract investors during the first nine months of trade, NASDAQ charged no transaction fees and paid a stipend to a select group of market makers.²⁷

²⁴ “Eurex Waives Transaction Fees for Euribor Products until Year-End,” MondoVisione, February 23, 1999, <http://www.mondovisione.com/media-and-resources/news/eurex-waives-transaction-fees-for-euribor-products-until-yearend/>. As another example, on March 31, 2015, Euronext announced the launch of its new dairy derivatives and waived all trading fees until June 30. “Euronext to Launch Dairy Derivatives on April 13,” Reuters, <https://www.reuters.com/article/euronext-dairy-launch/euronext-to-launch-dairy-derivatives-on-april-13-idUSL6N0WT3E320150331>.

²⁵ “CME Expands Efforts to Grow Trading Volume of Equity Index Options on Futures Markets,” CME Group Press Release, August 23, 2004, <http://investor.cmegroup.com/news-releases/news-release-details/cme-expands-efforts-grow-trading-volume-equity-index-options?ReleaseID=159344>.

²⁶ Napoli, Janet A., “Derivative Markets and Competitiveness,” *Economic Perspectives*, Federal Reserve Bank of Chicago, vol. 16, no. 4 (1992), pp. 13-24. “At the beginning of 1997, about 65% of Bund futures trading took place on LIFFE. During the next 21 months all trading volume switched to Eurex.” Pirrong, Craig, “Bund for Glory, Or It’s a Long Way to Tip a Market,” *Journal of Applied Corporate Finance*, vol. 27, no. 4, (Fall 2015), pp. 81-87.

²⁷ “Nasdaq Futures, Inc. (NFX or the Exchange), the designated contract market owned by Nasdaq, is establishing a new Designated Market Maker (DMM) program which will commence on the date the Exchange launches the previously-announced new NFX Energy Futures and Options Products (Energy Products) on or after June 1, 2015, and will continue for a period of nine months. The purpose of the program is to support liquidity in the Energy Products by recruiting DMMs to maintain competitive bid/ask spreads across the forward Contract curves, in Intra-Commodity (Time) Spreads, and in Inter-Commodity Spreads. The program will also enhance price discovery in the less liquid Energy Products by establishing commitments with DMMs to participate in a Request for Quotes process.” Nasdaq Futures CFTC Filing, Reference File SR-NFX-2015-15, April 2, 2015, <http://www.cftc.gov/filings/orgrules/rule040215nqfdcm001.pdf>; Nasdaq Futures CFTC Filing, Reference File SR-NFX-2015-11, March 11, 2015, <http://www.cftc.gov/filings/orgrules/rule031115nqfdcm001.pdf>; Meyer,

63. There are numerous historical examples of the successful migration of financial products from the OTC market to exchange trading. The following illustrative examples cover the (i) introductions of exchange trading of equity options and energy derivatives, and (ii) the entry by non-dealers onto pre-existing inter-dealer electronic central limit order book trading platforms for US Treasury securities.

1. Exchange Trading of Equity Options by CBOE in 1973

64. U.S. equity options were traded OTC from the late 18th century until the Chicago Board Options Exchange (CBOE) listed the first exchange-traded call options in April 1973 (with puts following soon afterward). High OTC transaction costs, and other costs related to setting up and maintain OTC trade relationships, had resulted in low trade volumes in the OTC options market.²⁸ Equity options trading quickly migrated to the CBOE.
65. Exchange trading of options on the CBOE began with 48 option series traded on 16 underlying securities for three different maturities. The volume of trade in the first full month of exchange trading, May 1973, exceeded the average monthly volume in any prior year of OTC trade. That highest-volume year for the OTC market was 1968, when options covering 2.52 million shares per month were traded in the OTC market. In May 1973, options covering 3.46 million shares per month were traded on the CBOE.
66. Between 1975 and 1976, exchange trading of call options was begun on the American Stock Exchange (AMEX), the Philadelphia Stock Exchange (PHLX), the Pacific Stock Exchange (PSE), and the Midwest Stock Exchange (MSE). Puts were listed on all five exchanges in June 1977.²⁹ The expectation of exponential growth in trade volumes after the inception of exchange trade is a powerful incentive to exchange operators to introduce exchange trading.
67. By the end of December 1983, the quantity of outstanding CBOE option contracts had grown since the inception of exchange trading by a multiple of 400. In many cases, the daily volume of options trade was higher than trade volume in the underlying equities. Option bid-ask spreads were typically ¼ cent or less, driven down in part by competition “from an average of more than fifteen Market Makers per OBO [Order Book Official]

Gregory, “Nasdaq Tempts Energy Traders with Extended Fee Holiday,” *Financial Times*, May 3, 2015, <https://www.ft.com/content/038c8d74-f033-11e4-ab73-00144feab7de>.

²⁸ Cox, John C. and Mark Rubinstein. *Options Markets*, Englewood Cliffs: Prentice Hall, 1985, Pint, pp. 23-24; Klemkosky, Robert C. and Terry S. Maness, “The Impact of Options on the Underlying Securities,” *Journal of Portfolio Management*, vol. 6, no. 2 (1980), p. 1; Finnerty, Joseph, “The Chicago Board Options Exchange and Market Efficiency,” *Journal of Financial and Quantitative Analysis*, March 1978, pp. 29-38.

²⁹ Cox and Rubinstein (1985), p. 24.

station.”³⁰ In 2016, 339 million equity options contracts were traded on CBOE, covering 33.9 *billion* shares of underlying stock.³¹

2. Entry of Non-Dealers onto CLOB Platforms for U.S. Treasuries

68. Trading in U.S. Treasury securities (“Treasuries”) migrated from voice-assisted to fully electronic CLOB platforms such as BrokerTec and eSpeed in the early 2000s. Using BrokerTec electronic data, Fleming, Mizrach, and Nguyen (2014, revised) found that this introduction of electronic platforms, merely being accessible to some non-dealers, led to “greater competition for liquidity provision and thus lower bid-ask spreads and market impact” for on-the-run (latest-issuance) Treasuries.³² Here, “market impact” refers to the impact of a given trade size on subsequent trade prices. A low market impact is a sign of a more liquid and efficient market, as it implies that the market is able to absorb the impact of a large order with a smaller price concession. Using GovPX and eSpeed data, Mizrach and Neely (2006) found that the introduction of electronic platforms led to greater volume, a narrowing of average spreads by 75% in two-year Treasuries and 82% in ten-year Treasuries, along with a reduction in market-impact price concessions of 74% on average.³³
69. In March 2015, the Managed Funds Association noted the importance of anonymity that BrokerTec provides to buy-side market participants on its trading platform as an element of BrokerTec’s success in becoming a “thriving market,” saying: “In the transition to electronic trading of U.S. Treasuries on BrokerTec, the buy-side’s access to that anonymous trading platform did not result in sell-side dealers providing less liquidity to the market. On the contrary, BrokerTec has become a thriving market that facilitates the majority share of daily volume in electronically traded U.S. Treasuries in North America.”³⁴

³⁰ Cox and Rubinstein (1985), pp. 24, 84.

³¹ CBOE, “CBOE Market Statistics 2016,” p. 77, <http://www.cboe.com/data/annualmarketstatistics.aspx>. One equity option contract is typically for 100 shares of the underlying equity security. For all exchanges, there was almost 2 billion equity options contracts traded, covering almost 200 *billion* shares of underlying stock

³² Fleming, Michael J., Bruce Mizrach, and Giang Nguyen, “The Microstructure of a U.S. Treasury ECN: The BrokerTec Platform,” Federal Reserve Bank of New York Staff Reports, Staff Report No. 381 (July 2009; revised March 2017), https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr381.pdf?la=en.

³³ Mizrach, Bruce and Christopher J. Neely, “The Transition to Electronic Communications Networks in the Secondary Treasury Market,” Review, Federal Reserve Bank of St. Louis Review, vol. 88, no. 6 (2006), pp. 527-541, <https://files.stlouisfed.org/files/htdocs/publications/review/06/11/Mizrach.pdf>.

³⁴ “Why Eliminating Post-Trade Name Disclosure Will Improve the Swaps Market,” *Managed Funds Association*, March 31, 2015, <https://www.managedfunds.org/wp-content/uploads/2015/04/MFA-Position-Paper-on-Post-Trade-Name-Disclosure-Final.pdf>.

70. As in foreign exchange markets,³⁵ a substantial fraction of liquidity provision in the US Treasuries market is offered by non-dealer principal trading firms (PTFs) using high-frequency trading strategies that only become feasible once trade migrates to CLOBs. In the case of Treasuries and foreign exchange markets, however, only a subset of buy-side firms, such as PTFs, have access to the CLOB platforms operated by inter-dealer brokers. The remainder of buy-side firms must still obtain their quotes from dealers, either bilaterally or on multi-dealer platforms, with a consequently higher execution costs and information leakage.³⁶

3. Energy Swaps Became “Futurized” and Migrated to Exchange Trading

71. The 2014 10-K for ICE noted that energy derivatives had successfully transitioned to a futures model with central clearing.

On October 15, 2012, we transitioned approximately 800 cleared OTC swaps contracts to our futures markets. Our cleared North American natural gas and power swaps were transitioned to ICE Futures U.S. For 2013, our transitioned energy futures contracts comprised 81% of ICE Futures U.S. average daily volume, with the remainder being agricultural and financial futures contract volume. Also, in October 2012 our cleared oil swaps were transitioned to ICE Futures Europe. For 2013, these futures and options comprised 6% of ICE Futures Europe’s average daily volume, with the exchange’s traditional energy futures contract volume comprising the remainder. The balance of the OTC swaps products that did not transition to futures remain bilaterally traded in our OTC markets[.]³⁷

72. A Bloomberg report noted that, “More than half of the \$18 trillion in notional daily trading of energy swaps has moved to futures exchanges from the over-the-counter market in response to the U.S. regulatory overhaul aimed at increasing transparency following the 2008 financial crisis.”³⁸

³⁵ Rime, Dagfinn, and Andreas Schrimpf, “The anatomy of the global FX market through the lens of the 2013 Triennial Survey,” *BIS Quarterly Review*, December 2013, https://www.bis.org/publ/qtrpdf/r_qt1312e.pdf.

³⁶ See, for example, Barnes, Dan, “The New Treasuries Protocols: Breaking Away from the Request-for-Quote Protocol Could Allow for Tighter Pricing without Information Leakage,” *FI-Desk*, June 4, 2018, <https://www.fi-desk.com/rates-trading-protocols-dan-barnes/>; Markets Committee, Financial Stability Board, “Monitoring of Fast-Paced Electronic Markets,” Bank for International Settlements, September, 2018, <https://www.bis.org/publ/mktr10.pdf>.

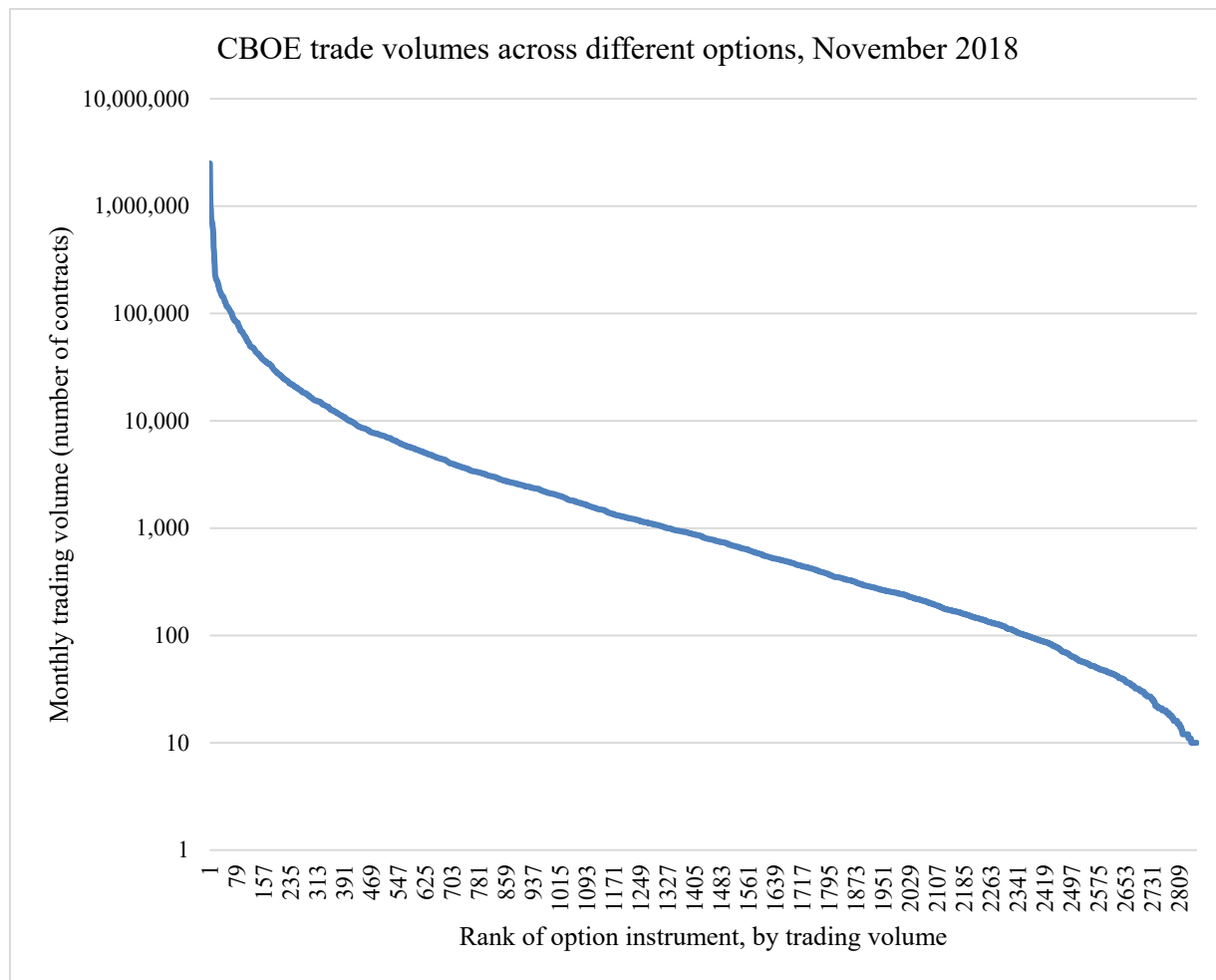
³⁷ Intercontinental Exchange Group, Inc., Form 10-K for the fiscal year ended December 31, 2013, p. 10.

³⁸ Leising, Matthew, “Energy Swaps Migrating to Futures on Dodd-Frank Rules,” *Bloomberg Law*, January 25, 2013.

C. All-to-All Trade of Benchmark Financial Products Supports the Viability of All-to-All Trade of Similar but Much Less Actively Traded Products

73. It is not necessary for all products within a given asset class to have high volumes of trade to justify their listing on exchanges and other anonymous all-to-all trade platforms. There benefits of liquidity and price transparency for active all-to-all trade in certain benchmark products can support the feasibility and economic viability of anonymous all-to-all trade, along with the associated benefits, for closely related but much less actively traded instruments.
74. For example, in November 2018, the CBOE listed 2,971 different types of equity option contracts with non-zero volumes of trade.³⁹ These options varied according to the identity of the underlying equity, the option expiration date, and the option exercise (“strike”) price. The top 1% of these options by trade volume (the top 30 options) had an average monthly volume per option type of 489,450 contracts. Each contract generally represents an option on 100 shares of the underlying equity. The top 25% of these options had an average monthly volume of 42,189 contracts. The bottom 25% of these options had an average monthly volume of only 54 contracts. There were 129 options with an average monthly volume of 10 contracts or fewer, although not zero volume. The full cross-sectional distribution of trade volumes across the different options is shown in the figure below, for options with an average monthly trade volume of at least 10 contracts.

³⁹ “Cboe Equity Option Volume Archive,” <http://www.cboe.com/data/historical-options-data/equity-option-volume>. November 2018 option volume Excel data file: http://www.cboe.com/Publish/TTMDAvgDailyVol/1811_rank_wosym.xlsx.



75. Clearly, the feasibility of exchange trading does not require that every financial instrument available on an exchange has a high volume of trade, for cases in which there are related financial instruments listed on the exchange that are actively traded.
76. As another example, the Chicago Mercantile Exchange offers anonymous all-to-all trade in Eurodollar interest-rate futures contracts. These futures are interest-rate derivatives used for risk management and other investment purposes that are closely related to the uses of IRS. As with standard IRS, payments on Eurodollar futures are based on LIBOR benchmark interest rates. As an illustrative example, the figure below displays the average daily trade volume for Eurodollar futures during a typical week, October 15 to October 19, 2018.⁴⁰ The notional outstanding position size associated with each contract is \$1 million, on a risk-equivalent basis.
77. As shown in the figure below, Eurodollar futures contracts with settlement months within one year tend to have high volumes of trade. Longer-dated Eurodollar futures, however,

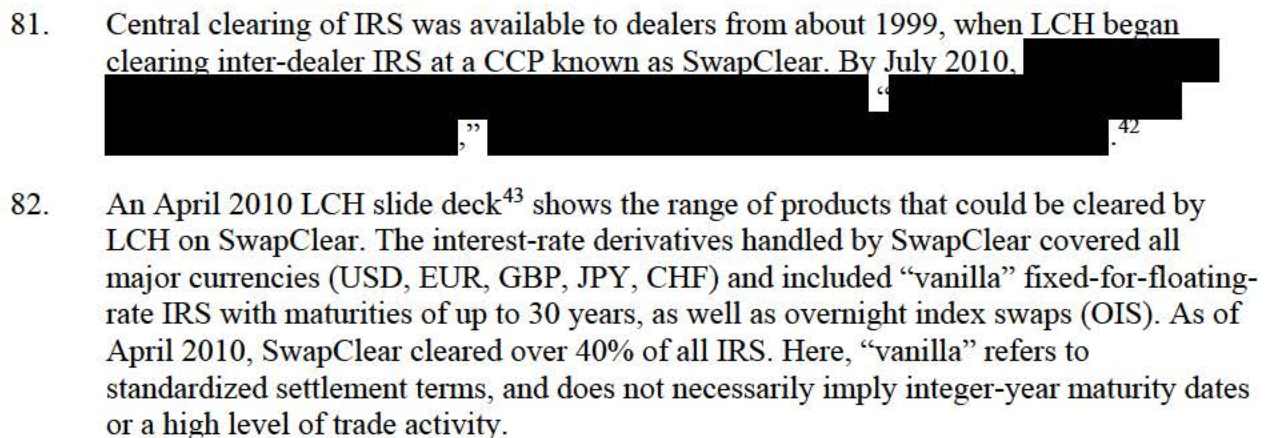
⁴⁰ "Interest Rate Futures," 2018 Daily Information Bulletin, CME Group, Inc., October 15, 2018–October 19, 2018, <ftp://ftp.cmegroup.com/bulletin/>.

tend to be more thinly traded. For example, the average daily trade volume in mid-October 2018 of Eurodollar futures maturing in December 2019 was over 300,000 contracts, whereas the average daily trade volume in Eurodollar futures for delivery in March 2025 was only 4 contracts. Yet there is sufficient support for the existence of exchange trading even for more thinly traded Eurodollar futures, in part because of the high volumes of trade in earlier settlement months. The listing of less actively traded contracts is supported by the improved price transparency stemming from more actively traded related contracts, and from the operational ease of strategies involving cross-contract hedging and speculation.

D. Central Clearing of IRS Was Supportable Before 2010

78. The mere fact that a product was not available on all-to-all trade venues or centrally cleared by a given date does not imply that the product could not have been traded and centrally cleared by that date in an anonymous all-to-all market setting.
79. In addition to supporting the viability of anonymous all-to-all trade, central clearing benefits buy-side firms through enhanced risk management and streamlined back-office functions. Central clearing also benefits the marketplace and the broader economy by enhancing financial stability.⁴¹
80. A law or regulation is not itself the basis for the operational feasibility of central clearing. The fact that central clearing of some buy-side IRS was introduced once this step was mandated by Dodd-Frank and the CFTC's implementing regulations makes it clear that feasibility had already been achieved some time before that regulatory step was taken.

⁴¹ See Duffie, Darrell, *How Big Banks Fail: and What To Do About It*, Princeton University Press, 2010, and Duffie, Darrell, "Financial Regulatory Reform After the Crisis: An Assessment," *Management Science*, vol. 64 (2018), pp. 4471-4965.



⁴³ LCH.Cleantnet Overview, April 2010, <https://secure.fia.org/downloads/Audio/Companion/LCH.Cleantnet.pdf>.

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83. The chart shown below, prepared by LCH.Clearnet, shows that volumes of IRS centrally cleared at SwapClear⁴⁴ had already reached about \$50 trillion in notional positions by 2005.



84. In response to an information request from the CFTC, in September 2011 LCH.Clearnet estimated the portion of IRS that would be available for clearing under the CFTC's mandate: "[REDACTED]"

45

85. In its Second Progress Report on OTC derivatives, the Financial Stability Board reported that an estimated 34% of interest rate derivatives were centrally cleared by July, 2011.⁴⁶

⁴⁴ LCH.Clearnet Overview, April 2010, <https://secure.fia.org/downloads/Audio/Companion/LCH.Clearnet.pdf>.

⁴⁵ [REDACTED], at '267-268.

⁴⁶ OTC Derivatives Market Reforms, Second Progress Report on Implementation, Financial Stability Board (FSB), October 11, 2011, p. 30, http://www.fsb.org/wp-content/uploads/r_111011b.pdf. The FSB was drawing from TriOptima data for July 1, 2011. In its Third Progress Report, based on TriOptima data from December 30, 2011, the FSB reported that 35% of interest rate derivatives were centrally cleared. See OTC Derivatives Market Reforms, Third Progress Report on Implementation, Financial Stability Board, June 15, 2012, p. 59, http://www.fsb.org/wp-content/uploads/r_120615.pdf. Four months later, in its Fourth Progress Report, the FSB similarly reported that 40% of interest rate derivatives were centrally cleared. See OTC Derivatives Market Reforms, Fourth Progress Report on Implementation, Financial Stability Board, October 31, 2012, pp. 60, 65, http://www.fsb.org/wp-content/uploads/r_121031a.pdf.

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86. It is operationally feasible to introduce the central clearing of buy-side IRS almost immediately after inter-dealer central clearing becomes available. The technical apparatus necessary for inter-dealer clearing is essentially sufficient to support buy-side clearing. The implementation of buy-side central clearing of standardized and actively traded IRS is neither operationally difficult nor time consuming, as demonstrated by experience in other derivatives that have made a transition to exchange trading.
87. Not all buy-side firms would necessarily want to bear the fixed costs of becoming clearing members of a CCP. Instead, some buy-side firms have their IRS cleared by agent clearing members, using the “futures commission merchant” (FCM) approach.⁴⁷ In the IRS market, the largest swap dealers are the FCMs who arrange for the bulk of the central clearing of buy-side swap positions, in part by collecting margin funds from their clients and placing those funds in accounts at the CCP on behalf of their clients. For decades, the FCM model has been the basis for buy-side central clearing of exchange-traded futures and options contracts. In the U.S., under the pressure of Dodd-Frank legislation and implementing CFTC regulations, the FCM approach was eventually used to centrally clear buy-side IRS. Even the largest buy-side firms benefit from the opportunity to have their swaps centrally cleared using the FCM model.
88. It is also operationally feasible for buy-side firms to clear interest-rate derivatives directly at a CCP (without going through an FCM), as has been done at derivatives clearinghouses operated by major international exchanges such as Eurex and BM&FBOVESPA.⁴⁸
89. While tangential to the basis of my opinion, I saw discovery evidence in this case indicating that the Defendant dealers recognized that buy-side central clearing was feasible by or before 2010. These materials include the following:

- [REDACTED] ⁴⁹
[REDACTED] indicated that [REDACTED] ⁵⁰

⁴⁷ Medero, Joanne and Richard Ostrander, “Start the Countdown: Implementation of Swaps Clearing in the U.S.” *ViewPoint*, BlackRock, Inc., September, 2012, <https://www.blackrock.com/corporate/literature/whitepaper/implementation-of-swaps-clearing-in-the-us.pdf>.

⁴⁸ “Spotlight On: Access Models for the Buy Side,” Eurex, June 2016, <http://www.eurexclearing.com/blob/2596124/5210ac0a3f1bacd58938420da8ccdeb6/data/spotlight-on-access-models-for-the-buy-side.pdf>; “Payment, Clearing and Settlement Systems in the CPSS Countries,” Committee on Payment and Settlement Systems, Bank for International Settlements, vol. 1, September 2011, p. 97, <https://www.bis.org/cpmi/publ/d97.pdf>.

⁴⁹ [REDACTED] ([REDACTED]), at ‘780 and ‘783; [REDACTED], at ‘055; “LCH.Clearnet Launches Buy-Side Clearing for Global OTC Interest Rate Swaps,” *Business Wire*, December 17, 2009, <https://www.businesswire.com/news/home/20091217005368/en/LCH.Clearnet-Launches-Buy-Side-Clearing-Global-OTC-Interest>.

⁵⁰ [REDACTED], at ‘055.

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- In [REDACTED], [REDACTED] predicted in an internal report that because [REDACTED]
[REDACTED]”⁵¹
- [REDACTED], a twenty-year veteran of [REDACTED] who was the [REDACTED] from [REDACTED]
testified as follows. “
[REDACTED]
[REDACTED]”⁵²

90. Although the majority of buy-side IRS trades were not centrally cleared until after the CFTC mandate took effect in 2013, it was operationally feasible to clear client IRS trades well before then. The central clearing mandate of the Dodd-Frank Act was not based on newly emerging technology. Instead, Dodd-Frank effectively forced dealers to deploy pre-existing central clearing technology on a wider basis. As stated by the CFTC, “In the Dodd-Frank Act, Congress directed that clearing shift from a voluntary practice to a mandatory practice for certain swaps and gave the Commission responsibility for determining which swaps would be required to be cleared.”⁵³

E. Electronic Trade Facilities Could Have Supported All-to-All Buy-Side IRS by 2005 and Additional Standardized OTC Interest-Rate Derivatives by 2010

91. As I have emphasized, neither the feasibility nor the economic viability of anonymous all-to-all trade of a financial product, at a given point in time, require that the product has already achieved the volume, breadth of participation, standardization, and trade frequency that would normally be needed to make all-to-all trade viable. Rather, in a world characterized by lack of interference by dealers, the key test is whether the product would have reasonably been offered, in a suitably standardized form, for anonymous all-to-all trading by platform operators. Trade-venue operators maximize expected future profits and rationally consider the increases in volume, breadth of participation, and trade frequency that would be expected after the advent of anonymous all-to-all trade.
92. Consider, for example, the impacts that I have described in Sections III.A and III.B of the introduction of exchange trading, or the broadening of participation of exchange trading, on volumes of trade in SOFR futures, equity options, Treasuries, and energy futures. Trade platform operators rationally accept the risk of incurring the fixed costs of setting up all-to-all trade, only to later discover in some cases that trade volumes may turn out to be insufficient to continue offering this form of trade. It is efficient for the market, and beneficial to buy-side firms and trade platform operators, that platform operators are free to explore these options to introduce anonymous all-to-all trade.

⁵¹ [REDACTED], at ‘400.

⁵² [REDACTED] Tr. 67:20-68:20.

⁵³ 77 Fed. Reg. 74,284 at 74,322, December 13, 2012.

93. I have already described above the high volumes of trade and outstanding notional amounts of IRS that existed in 2007. Even as early as 2004, the BIS Triennial Survey shows average turnover of OTC interest rate derivatives of \$347 billion dollars per day. As a point of reference on levels of exchange trade of interest rate derivatives that would be considered “active,” in 2014 three economists at the Bank for International Settlements (Lawrence Kreicher, Robert McCauley, and Philip Wooldridge) wrote⁵⁴ that, “We define active as a bond futures market in which average daily turnover in all contracts exceeded \$2 billion in the month of September 2013.”
94. Although the total amount of trading of OTC interest rate derivatives was spread over a large number of types of products, there was a high volume of trade in benchmark IRS. For example, economists at the Federal Reserve Bank of New York conducted a study⁵⁵ of the composition of trading activity in OTC interest-rate derivatives in mid-2010, finding that “[t]he IRD market also displayed a concentration of trade activity in particular tenors, with almost 60% of the transactions in the top products and currencies occurring in a small number of benchmark instruments” and that “IRS displayed elevated activity at tenors reflecting liquid sovereign issuance points. Spot trading in 2-, 3-, 5-, 10- and 30-year swaps represented around 57% of the G4 IRS activity and 46% of the notional volume.” Here, “G4” refers to the four major currencies (US dollars, Euros, British pounds, and Japanese Yen).
95. The authors of the same Federal Reserve study went on to comment that, “Nonetheless, we noted that even in the most commonly traded tenors, the number of transactions per day was not high by the standards of many other markets.” As I have emphasized, the amount of trade conducted in an OTC market before the advent of anonymous all-to-all trade is only a signal of the much larger amounts of trade that would be conducted after a migration of trade to anonymous all-to-all platforms. This is especially the case with respect to frequency of trade, given the low costs of order submission and rapid execution afforded by CLOBs. Further, CLOBs allow algorithmic (including high-frequency) trading strategies, increasing market depth and trade frequency.
96. According to the Bank for International Settlements,⁵⁶ the total outstanding notional amount of IRS in 2004 was \$147 trillion. Of the total outstanding amount of OTC interest rate derivatives positions held in late 2004, about half was between dealers and non-dealer financial firms, implying a large potential amount of trade that could have feasibly

⁵⁴ See Kreicher, Lawrence, Robert N. McCauley, and Philip Wooldridge, “Benchmark Tipping in the Global Bond Market,” Monetary and Economic Department, Bank for International Settlements, October 2014, <https://www.bis.org/publ/work466.pdf>.

⁵⁵ Fleming, Michael, John Jackson, Ada Li, Asani Sarkar, and Patricia Zobel, “An Analysis of OTC Interest Rate Derivative Transactions: Implications for Public Reporting,” Federal Reserve Bank of New York Staff Reports, Staff Report No. 557 (March 2012; revised October 2012), https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr557.pdf.

⁵⁶ Monetary and Economics Department, Bank for International Settlements, “OTC derivatives market activity in the second half of 2004,” May, 2005. https://www.bis.org/publ/otc_hy0505.pdf.

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migrated from the OTC market to all-to-all trade.⁵⁷ Of the total global outstanding amount of OTC interest-rate derivatives, \$147 trillion was in the form of IRS.

97. I have stated that, by 2005, benchmark types of fixed-for-floating IRS were sufficiently standardized and actively traded for the feasibility and economic viability of anonymous all-to-all trade with straight-through processing, including central clearing. Later in this report, I will discuss the feasibility of anonymous all-to-all trade in other OTC interest rate derivatives.
98. The technology supporting all-to-all IRS trade existed in the inter-dealer market as early as 2005, when a multi-dealer RFQ was introduced by Tradeweb.⁵⁸ By that point in time, it was also operationally feasible for the clients of dealers to execute trades on Tradeweb.⁵⁹
99. While the existence of central clearing and all-to-all trade facilities supported the feasibility of all-to-all trade, these conditions do not imply that a migration of OTC trade to all-to-all venues will occur as soon as the buy-side and trade platform operators would benefit from such a migration. Dealers have had an incentive to block such a migration. As I have explained, dealers suffer from a migration to anonymous all-to-all trade through a reduced average profit margin on each trade they intermediate (caused by increased competition and price transparency), and also from a reduction in the fraction of trades that they intermediate (because of some disintermediation by buy-side firms). Absent all-to-all trade, dealers intermediate all or essentially all trades. A migration to anonymous all-to-all trade would have dramatically lowered total dealer profits in the IRS market. I have seen abundant evidence produced in discovery that is consistent with my opinion regarding the nature of the dealers' incentives to avoid a transition to central clearing and all-to-all trade.
100. An internal presentation on market structure to [REDACTED]' management committee stated.⁶⁰ [REDACTED]
[REDACTED]
[REDACTED]

⁵⁷ "OTC Derivatives Market Activity in the Second Half of 2004," Bank for International Settlements, May 2005, Table 3, https://www.bis.org/publ/otc_hy0505.pdf.

⁵⁸ Treasury Presentation to TBAC, Office of Debt Management, Fiscal Year 2013 Q4 Report, p. 56, [https://www.treasury.gov/resource-center/data-chart-center/quarterly-refunding/Documents/Nov%202013%20QR%20-%20TBAC%20Discussion%20Charts%20\(Final\).pdf](https://www.treasury.gov/resource-center/data-chart-center/quarterly-refunding/Documents/Nov%202013%20QR%20-%20TBAC%20Discussion%20Charts%20(Final).pdf).

⁵⁹ "First Fully-Electronic Interest Rate Swap Trade Executed and Cleared in U.S.," Tradeweb, November 18, 2010, <https://www.tradeweb.com/newsroom/media-center/news-releases/first-fully-electronic-interest-rate-swap-trade-executed-and-cleared-in-u.s/>.

⁶⁰ [REDACTED] ([REDACTED]), at '630.

- F. Lack of Trade Anonymity on Inter-Dealer Platforms Artificially Impeded Buy-Side Participation on these Platforms**

- 61 [REDACTED] ([REDACTED]).

62 The

63 [REDACTED], p. 16.

64 [REDACTED], p. 2.

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107. One would expect that dealers had the incentive to ensure that legacy inter-dealer CLOB SEFs would not morph into anonymous all-to-all platforms. Consistent with this incentive, I have seen evidence suggesting that the Defendant dealers sought to enforce name give-up in order to ensure that buy-side firms did not participate on these platforms. Examples include:
108. A May 31, 2013 internal email from [REDACTED] of [REDACTED] with the subject line "[REDACTED]" states: [REDACTED]
[REDACTED]⁶⁵
109. [REDACTED]' internal strategy discussions in 2013 regarding [REDACTED] noted that "[REDACTED]"⁶⁶
110. In a Risk Magazine interview,⁶⁷ Ken Griffin, CEO of Citadel, "argue[d] that name give-up benefits dealers at the expense of clients, allowing them to 'position their book by taking advantage of their trading counterparties' market insights."
111. The Managed Funds Association wrote in 2015: "There is no commercial, operational, credit, or legal justification for the legacy practice of post-trade name disclosure (or 'give-up') to continue on SEFs that offer anonymous execution of cleared swaps. While the practice may have served a purpose prior to the implementation of the current swaps trading and clearing regime, today it needlessly reveals the identities of counterparties to otherwise anonymous trades. Post-trade name disclosure is a legacy feature of uncleared, inter-dealer markets that perpetuates a bifurcated, two-tier swaps markets within the SEF landscape, and undermines the Dodd-Frank Act's policy goals of promoting SEF trading of cleared swaps and enhancing price transparency and competition. Eliminating post-trade name disclosure will increase the diversity, breadth, and depth of liquidity on SEFs and thereby reduce the potential for market volatility and disruptions. Other financial markets that have undergone a similar transition (such as the U.S. Treasuries market) have realized these benefits."⁶⁸
112. The Managed Funds Association also wrote that "[a] key mechanism suppressing buy-side trading on IDB SEFs and perpetuating the current two-tier market structure is the

⁶⁵ [REDACTED].

⁶⁶ [REDACTED]. A May 31, 2013 [REDACTED] internal email re [REDACTED] that [REDACTED]."
[REDACTED]."

⁶⁷ Devasabai, Kris, "Citadel's Ken Griffin on Amazon, Bloomberg and Swap Market Reform," *Risk*, October 31, 2014, <https://www.risk.net/asset-management/hedge-funds/2377762/citadels-ken-griffin-amazon-bloomberg-and-swap-market-reform>.

⁶⁸ "Why Eliminating Post-Trade Name Disclosure Will Improve the Swaps Market," *Managed Funds Association*, March 31, 2015, p. 1, <https://www.managedfunds.org/wp-content/uploads/2015/04/MFA-Position-Paper-on-Post-Trade-Name-Disclosure-Final.pdf>.

legacy practice of post-trade name disclosure. Even though otherwise eligible buy-side participants have access to all SEFs in theory, the loss of anonymity caused by the continuation of post-trade name disclosure deters buy-side access to IDB SEFs in practice. Among its other adverse effects, post-trade name disclosure is a source of random and uncontrolled ‘information leakage’ and perpetuates informational and trading advantages of traditional dealers. MFA strongly believes that the CFTC needs to intervene to remove this artificial barrier to buy-side participation on IDB SEFs by requiring such SEFs to maintain post-trade anonymity. This regulatory action would make the SEF marketplace more attractive to buy-side firms by allowing more flexible and efficient execution of both outright swaps and package transactions. We expect that this action will increase the volume of buy-side trading on SEFs.”⁶⁹

113. The Managed Fund Association also responded to claims that name disclosure is needed to prevent traders from using the CLOB to affect RFQ quotes:

Some have argued that the practice of post-trade name disclosure should be preserved to prevent buy-side firms from “gaming” the market. Proponents of this view claim that buy-side firms could post a low resting bid (or high resting offer) in an anonymous CLOB, and then solicit a dealer through an RFQ to motivate the dealer to lower its price in reliance upon the price level posted in the CLOB. This theoretical risk exists in any market that employs both anonymous and disclosed trading protocols and historically, has not risen to a level of serious concern. The Treasury securities and foreign exchange markets, for example, have operated for years with both anonymous and disclosed execution channels, and participants have been able to trade across both without concerns of gaming. Nothing about the swaps market necessitates a different policing paradigm from other markets. Further, SEF CLOBs require market participants to post firm resting bids/offers. SEF participants that attempt to “game” dealers on pricing would be at risk of their firm offers being matched, resulting in potentially unfavorable positions. The likelihood of detection for engaging in any gaming behavior, regardless of whether or not a SEF uses post-trade name disclosure in its market, also serves as a strong deterrent. Such actions carry serious reputational and enforcement risks that buy-side market participants naturally avoid.⁷⁰

⁶⁹ “Why Eliminating Post-Trade Name Disclosure Will Improve the Swaps Market,” *Managed Funds Association*, March 31, 2015, p. 2, <https://www.managedfunds.org/wp-content/uploads/2015/04/MFA-Position-Paper-on-Post-Trade-Name-Disclosure-Final.pdf>.

⁷⁰ “Why Eliminating Post-Trade Name Disclosure Will Improve the Swaps Market,” *Managed Funds Association*, March 31, 2015, p. 7, <https://www.managedfunds.org/wp-content/uploads/2015/04/MFA-Position-Paper-on-Post-Trade-Name-Disclosure-Final.pdf>.

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- [illegible]

⁷¹ Kelleher, Dennis, Caitlin Kline, and Victoria Daka, “Stopping Wall Street’s Derivatives Dealers Club,” Better Markets Policy Brief, February 2016, <https://bettermarkets.com/sites/default/files/Better%20Markets%20Policy%20Brief%20-%20Stopping%20Wall%20Street%E2%80%99s%20Derivatives%20Dealers%20Club.pdf>.

72 [REDACTED], at '922.

73 [REDACTED], at '922.

74 [REDACTED], p. 2.

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117. In some trading situations, a large buy-side firm may wish to disclose its identity in order to signal that it wishes preferential treatment from dealers, given the benefit to the dealer associated with follow-on business with the same large customer. This clearly does not imply that large buy-side firms prefer to have no option to conduct anonymous all-to-all trade. Large buy-side firms may often prefer anonymity. Moreover, as I have emphasized, all market participants prefer to have access to the lower execution costs afforded by active anonymous all-to-all trade venues, and benefit from the opportunity to earn profits by supplying liquidity on these venues to other market participants.
118. Consistent with this view, an internal email on “[REDACTED]” from [REDACTED] [REDACTED] cites “[REDACTED]”⁷⁵
119. On September 24, 2013, staff from [REDACTED] and [REDACTED] held a market structure conference call on which, according to the call notes,⁷⁶ [REDACTED] said it “[REDACTED]”
120. In a 2013 internal email from [REDACTED] of [REDACTED] on the subject of [REDACTED] [REDACTED]⁷⁷
121. A 2011 internal email from [REDACTED] of [REDACTED] states that, “[REDACTED]”⁷⁸
122. In a 2012 internal email, [REDACTED] of [REDACTED], an [REDACTED] [REDACTED] wrote: [REDACTED]
[REDACTED]⁷⁹ I understand the “[REDACTED]” to refer to [REDACTED]

G. Dealers Had the Incentive to Prevent the IRS Market from Moving to Anonymous All-to-All Trade

123. The Defendants’ strategy documents that I reviewed are consistent with the incentives that I have discussed regarding the risk to the Defendants’ business franchises associated

⁷⁵ [REDACTED].

⁷⁶ [REDACTED]. The call notes were taken by [REDACTED].

⁷⁷ [REDACTED], at ‘531.

⁷⁸ [REDACTED].

⁷⁹ [REDACTED].

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with a transition of the IRS market structure to one based heavily on all-to-all anonymous trade. These include:

124. A 2008 draft internal [REDACTED] presentation on “[REDACTED]” [REDACTED]”⁸⁰ predicts the [REDACTED].”
125. A 2010 [REDACTED] internal draft presentation, “[REDACTED]”⁸¹ discusses the [REDACTED], stating that the [REDACTED]. It describes the “[REDACTED]” [REDACTED]. The presentation noted that a “[REDACTED]” in the [REDACTED] was [REDACTED]. The presentation listed the “[REDACTED]”, including: “[REDACTED]”⁸²
126. In a September 2010 [REDACTED] internal email, [REDACTED] ([REDACTED]) wrote: “[REDACTED]”⁸³ In the same email, [REDACTED] wrote: “[REDACTED]”⁸⁴ He further elaborated: [REDACTED]”⁸⁵
127. In January 2013, [REDACTED] [REDACTED] wrote, with respect to a draft strategy document: “[REDACTED]”⁸⁶ The same email attached the referenced [REDACTED], which discussed a “[REDACTED]” in which “[REDACTED]”⁸⁷ such as the [REDACTED] were “[REDACTED]”⁸⁷ The strategy document later

⁸⁰ [REDACTED], p. 12.

⁸¹ [REDACTED] ([REDACTED]), at ‘914.

⁸² [REDACTED] ([REDACTED]), at ‘912.

⁸³ [REDACTED].

⁸⁴ [REDACTED].

⁸⁵ [REDACTED].

⁸⁶ [REDACTED] ([REDACTED]).

⁸⁷ [REDACTED] ([REDACTED]), at ‘638.

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describes the risk that “ [REDACTED] ”
 would make an “ [REDACTED] ”
 [REDACTED] That same page also
 notes the risk that, [REDACTED]

”⁸⁸

128. A 2014 [REDACTED] strategy document similarly made a “ [REDACTED] ”
 [REDACTED] ⁸⁹ The document then
 listed the “ [REDACTED] ” and their attributes: [REDACTED]

”⁹⁰

IV. THE IRS MARKET COULD HAVE QUICKLY TRANSITIONED TO AN ALL-TO-ALL ANONYMOUS TRADING MODEL NO LATER THAN 2013

129. If one or more all-to-all anonymous trade platforms had gained some traction in the IRS market, the majority of the market for any such “listed” products would have rapidly transitioned to all-to-all anonymous trading.
130. There would have also been significant substitution out of products that had not yet made a transition to all-to-all trade and into products that had made this transition, in order to take further advantage of the benefits of anonymous all-to-all trade that I have described, including better pricing terms, more transparency, and more efficient trade execution. Later in this report, I will further describe the basis for this substitution effect between “listed” and “unlisted” products.
131. A transition of some products onto an all-to-all trade platform does not rule out the persistence of some “off-exchange” trade in the same product and in some closely related financial products. With the availability of anonymous all-to-all trade of a financial product, there remains a role for some “off-exchange” block trades of the same product. The majority of trade in publicly issued equities is done on exchanges, but a non-trivial fraction of trade remains over the counter, for example in the form of block trades in the “upstairs” market.⁹¹ There also remains a role for some customization of IRS and related products that are tailored to highly specific buy-side needs.

⁸⁸ [REDACTED] ([REDACTED]), at 658.

⁸⁹ [REDACTED] ([REDACTED]), at ‘076.

⁹⁰ [REDACTED] ([REDACTED]), at ‘076.

⁹¹ Keim, Donald B. and Ananth Madhavan, “The Upstairs Market for Large-Block Transactions: Analysis and Measurement of Price Effects,” *Review of Financial Studies*, vol. 9, no. 1 (1996), pp. 1-36.

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132. It is a well-established principle of financial markets that “[REDACTED]”.⁹² Whether liquidity is created in a particular financial instrument or on a particular trading venue, the benefits of trade activity and market depth are an incentive for market participants to take further advantage of these benefits by increasing the fraction of their trades in the more liquid product or on the more liquid trade venue, further magnifying its relative and absolute level of liquidity.
133. Once a migration to anonymous all-to-all trade begins, the resulting increase in market depth and trade activity encourages additional migration onto all-to-all trade platforms, creating a more liquid all-to-all anonymous marketplace.⁹³ As I have described earlier in this report, buy-side firms would have contributed to all-to-all market depth through their own provision of immediacy on these platforms.
134. Given the positive feedback effect by which increasing trade activity and market depth at a given trade venue supports even more such trade and market depth, the migration of trade from the bilateral or RFQ market to an anonymous all-to-all trade platform would, after achieving an initial amount of traction, be expected to grow rapidly. This transition phenomenon is sometimes called a liquidity “tipping point,” meaning the point at which the benefits of migration to a new trade venue or financial product have become sufficiently clear to market participants that the associated economies of scale and positive liquidity externalities become dominant, and speed up the transition.
135. An illustration of how quickly exchange trade activity can benefit from an improvement in market structure is the Big Bang experienced by the London Stock Exchange on October 27, 1986, when restrictions on trade commissions were lifted and electronic trading was introduced. As reported 30 years later by the British Broadcasting Corporation “All this meant that the volume of trade that flooded through the new terminals soared, averaging more than \$7.4bn a week after Big Bang compared with

⁹² See [REDACTED] ([REDACTED]) writing in a 2014 email: “[REDACTED]”; Zigler, Brad, “The Futures (and Options) of the Nasdaq 100,” *The Street*, November 13, 1999, <https://www.thestreet.com/story/818140/1/the-futures-and-options-of-the-nasdaq-100.html> (“Options traders, more than other traders, have a strong herd instinct. We’re attracted to markets already populated by our kind. Simply put, liquidity begets liquidity. Liquidity is made manifest in the metrics of volume and open interest.”); Mainelli, Michael, “Liquidity = Diversity,” *Journal of Risk Finance*, vol. 9, no. 2, 2008, pp. 211-216 (“There is an old phrase that ‘liquidity begets liquidity’ meaning, simply, that once some people start trading, more people will join them.”);

⁹³ Deposition testimony I have seen consistent with this conclusion includes: [REDACTED] 83:5-84:3 (“[REDACTED]”).

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\$4.5bn a week beforehand.”⁹⁴ Average daily turnover increased from about 400,000 pounds in the year before the Big Bang to over 2,000,000 pounds the year after.⁹⁵

136. Although again confirmative, and not the basis of my opinion, I have seen discovery indicating that the dealers recognized that anonymous all-to-all IRS trade venues were viable, absent dealer interference, given the positive feedback incentive for any given investor to trade on these venues when other investors trade on these venues.
137. In a 2011 presentation created by [REDACTED], [REDACTED], and entitled “ [REDACTED] ” predicted that, “ [REDACTED] ”⁹⁶ also stated that, “ [REDACTED] ”⁹⁷ This included a “ [REDACTED] ” because “ [REDACTED] ”⁹⁸ Here, I understand “ [REDACTED] ” to refer to [REDACTED]. That is, [REDACTED].
138. A 2014 presentation of [REDACTED] states that, “ [REDACTED] ”⁹⁹
139. A November 2012 “ [REDACTED] ” presentation prepared by [REDACTED] noted the risk ([REDACTED]) that: “ [REDACTED] ” and that “ [REDACTED] ”¹⁰⁰
140. [REDACTED], [REDACTED]’s [REDACTED], [REDACTED], wrote, in a 2013 internal email, “ [REDACTED] ”

⁹⁴ Robertson, Jamie, “How the Big Bang Changed the City of London Forever,” *BBC News*, October 27, 2016, <https://www.bbc.com/news/business-37751599>.

⁹⁵ While trade volumes went down from 1987 to 1988, turnover never dropped below 250% of its level in the year before the Big Bang. See, Market Information and Analysis, London Stock Exchange, <https://www.londonstockexchange.com/statistics/historic/stats-summary-pre-2005/pre-2005.pdf>.

⁹⁶ [REDACTED], p. 1.

⁹⁷ [REDACTED], p. 5.

⁹⁸ [REDACTED], p. 6.

⁹⁹ [REDACTED], p. 3.

¹⁰⁰ [REDACTED], at ‘241. Emphasis added with italics.

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141.

142. In summary, as more and more trade of an interest-rate derivative migrates onto anonymous all-to-all trade venues, this migration is accelerated by the increasing relative cost to buy-side firms of using RFQ protocols.

V. SEVERAL EMERGENT ALL-TO-ALL ANONYMOUS TRADING PLATFORMS WOULD HAVE BENEFITED ALL OR NEARLY ALL CLASS MEMBERS

A. Bloomberg, Javelin, Tera, and trueEX Offered Anonymous All-to-All Trading Platforms for Interest Rate Swaps

143. In 2013, Bloomberg was the first platform operator to submit an IRS SEF application and was also the first firm to receive approval from the CFTC to operate a SEF.¹⁰³ From the launch of its IRS SEF through April 4, 2018 (the latest available cutoff date for Bloomberg's data production), all but five IRS trades on Bloomberg's IRS SEF have been based on the RFQ protocol.¹⁰⁴
144. Platform operators trueEX Group LLC ("trueEX"), TeraExchange, LLC ("Tera"), and Javelin SEF ("Javelin") quickly followed with applications with the CFTC. By October 1, 2013, Tera, trueEX, and Javelin had all received temporary approval to operate as IRS

¹⁰¹ [REDACTED]. Emphasis added with italics.

¹⁰² Notes by [REDACTED], [REDACTED], titled "[REDACTED]" explain that, "[REDACTED]"

¹⁰³ "Bloomberg First: Day One of SEF Trading," *Bloomberg*, October 3, 2013, <https://www.bloomberg.com/company/announcements/bloomberg-first-day-one-of-sef-trading/>.

¹⁰⁴ See Footnote 13.

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SEFs.¹⁰⁵ trueEX was previously designated as a Designated Contract Market (“DCM”) in September 2012.¹⁰⁶

145. The all-to-all anonymous trading platforms that are (or were) offered by Javelin, Tera, trueEX, and Bloomberg during the class period are exchange-like anonymous all-to-all platforms. Had at least one of these anonymous all-to-all trade platforms been successful in gaining traction in the IRS market, the buy-side benefits that I have described would have occurred.

B. Inter-Dealer Brokers Could Have Offered Anonymous All-to-all Trade

146. In addition to the emergent anonymous all-to-all trading platforms of Javelin, Tera, trueEX, and Bloomberg, inter-dealer brokerage firms such as ICAP and Tradition had the capability of adapting their existing inter-dealer CLOB facility so as to offer all-to-all anonymous trading. As I stated previously, dealers have the incentive to prevent legacy inter-dealer-broker platforms from morphing into anonymous all-to-all platforms, thereby disintermediating the dealers. This is an incentive which, as documents produced in discovery indicate, the dealers recognized. For example:

147. In a September 6, 2011 email, [REDACTED], [REDACTED] wrote: “ [REDACTED] ”¹⁰⁷

148. A September 2013 [REDACTED] presentation predicted that the “ [REDACTED] ” and that “ [REDACTED] ” and “ [REDACTED] ”¹⁰⁸

149. Assuming there had been no coordinated dealer interference, the migration of IRS buy-side trade onto IDB CLOB platforms would have occurred naturally, given the incentives of these platform operators to earn additional revenues, the incentives of buy-side firms to benefit from lower execution costs through anonymous all-to-all trade, and the individual incentive of each dealer to earn market-making profits by offering quotes on these platforms, especially if other dealers declined to take this opportunity.

150. Evidence produced in discovery, however, [REDACTED]

¹⁰⁵ Skarecky, Tod, “SEF’s: A Brief History (One Day to Go),” *Clarus Financial Technology*, September 20, 2013, <https://www.clarusft.com/sef-a-brief-history-of-time/>.

¹⁰⁶ trueEX, <https://www.trueex.com/about-us>.

¹⁰⁷ [REDACTED]. Emphasis added with italics.

¹⁰⁸ [REDACTED], p. 8.

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A 2012 [REDACTED] document, for example, states that [REDACTED]

¹⁰⁹ In a 2012 [REDACTED] email, [REDACTED] ([REDACTED]), [REDACTED] stated that “ [REDACTED] ”

¹¹⁰ The minutes of a [REDACTED] held on June 21, 2012, show that [REDACTED] ([REDACTED]), [REDACTED]

The same minutes indicate that [REDACTED] ([REDACTED]) “ [REDACTED] ”
¹¹¹ [REDACTED]

C. Active All-to-All Trade on Javelin, Tera, trueEX, Bloomberg, or IDB CLOB Platforms Required Some Provision of Liquidity by Dealers

151. I have explained that anonymous all-to-all trade of IRS was viable before 2010. One may then ask why this form of trade did not actually flourish once it was offered to the market by Javelin, Tera, trueEX, and Bloomberg. [REDACTED]

[REDACTED]
¹¹² [REDACTED]

152. Even an established futures or stock exchange relies on market makers to deepen the provision of immediacy by absorbing excess order flows from buy-side firms in return for bid-ask-spread price concessions. Likewise, an all-to-all IRS trade platform relies on swap dealers for the provision of meaningful price quotes, by which I mean price quotes that are designed to compete for trades and have a meaningful likelihood of being accepted by other market participants. Individually, each swap dealer has a profit incentive to participate in meaningful quote provision on these all-to-all platforms. This profit incentive for a given dealer is much bigger if other dealers decline to participate in the competition for all-to-all orders, for that leaves the sole participating dealer with a 100% share of the market-making profits on the platform.
153. In their seminal 1988 research on the economics of market making, economist Sanford Grossman and Nobel-prize-winning economist Merton Miller wrote that, “Market makers supply immediacy by their continuous presence and willingness to bear risk during the

¹⁰⁹ [REDACTED]

¹¹⁰ [REDACTED]

¹¹¹ [REDACTED]

¹¹² [REDACTED] Dep. Tr. 114:12-20 ([REDACTED]

[REDACTED]).

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time period between the arrival of final buyers and sellers. In the long run the number of market makers adjusts to equate the supply and demand for immediacy. This determines the equilibrium level of liquidity in the market.”¹¹³ And yet the evidence that I have reviewed reveals that the Defendant dealers, who constituted the majority of the market-making capacity in the IRS swap market, failed to participate in profit-making opportunities to provide liquidity on these emergent all-to-all platforms. This is consistent with the collective incentive of the dealers, given their nearly complete dominance of intermediation of the IRS market. As I have explained, once anonymous all-to-all trade becomes successful, the average dealer profit margin on each trade declines and the fraction of trades intermediated by dealers, in aggregate, also declines.

154. I have reviewed evidence produced in discovery reflecting [REDACTED]

¹¹⁴ For example, in June 2014, [REDACTED] ([REDACTED]) reported about “ [REDACTED] ”¹¹⁵ testified that this meant that “ [REDACTED] ” were “ [REDACTED] ”¹¹⁶

155. An internal [REDACTED] presentation dated July 2015 explained an [REDACTED] :

“ [REDACTED] ”¹¹⁷

¹¹³ Grossman, Sanford and Merton Miller, “Liquidity and Market Structure,” *Journal of Finance*, vol. 43 (1988), pp. 617-633.

¹¹⁴ See, for example, [REDACTED] . Tr. 92:9-14 (testifying that [REDACTED]

[REDACTED]); Dep. Tr. 209:2-5 (testifying that [REDACTED]

Dep. Tr. 305:2-6 (testifying that, “ [REDACTED] ” when asked [REDACTED]

Dep. Tr. 261:12-20 (testifying that “ [REDACTED]

[REDACTED] ”); Dep. Tr. 97:20-98:2 (testifying that [REDACTED]

Dep. Tr. 96:22-24 (testifying that “ [REDACTED]

88:8-12 (testifying that “ [REDACTED] ” and that “ [REDACTED]

[REDACTED] ”); Tr. 97:3-13 [REDACTED]

).

¹¹⁵ [REDACTED] , at ‘298 (6/11/2014 email) (“ [REDACTED]

[REDACTED]).

¹¹⁶ [REDACTED] Dep. Tr. 144:7-15.

¹¹⁷ [REDACTED] , p. 2; [REDACTED] Dep. Tr. 120:6-9 (“ [REDACTED]

[REDACTED] ”); Dep. Tr. 80:3-10 ([REDACTED]

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156. In December 2012, [REDACTED] at [REDACTED] asked a colleague, “ [REDACTED]”¹¹⁸ and, [REDACTED] reported that “ [REDACTED]”¹¹⁹ In April 2013, [REDACTED] ([REDACTED]) emailed [REDACTED] ([REDACTED]) to ask “ [REDACTED]”¹²⁰ [REDACTED] responded: “ [REDACTED]”¹²¹

157. [REDACTED] testified that [REDACTED]¹²²

158. The lack of actual trade volumes on emergent all-to-all trade platforms is consistent with dealer incentives to halt or at least delay Bloomberg’s all-to-all SEF platform.

- A 2013 [REDACTED] email concerning [REDACTED] describes “ [REDACTED]”¹²³

- According to [REDACTED] ([REDACTED]), “ [REDACTED]”¹²⁴

D. All-to-All Anonymous IRS Trading Would Have Benefitted All or Nearly All Members of the Proposed Class

159. Having reviewed the all-to-all anonymous platforms offered by Javelin, Tera, trueEX, and Bloomberg, my opinion is that if any of these platforms had succeeded in gaining traction in the IRS market, all or nearly all buy-side market participants would have experienced substantial benefits. The same benefits would have accrued to buy-side

¹¹⁸ [REDACTED], at ‘291.

¹¹⁹ [REDACTED].

¹²⁰ [REDACTED] ([REDACTED] Ex. [REDACTED]).

¹²¹ [REDACTED] ([REDACTED] Ex. [REDACTED]). See also [REDACTED] Dep. Tr. 67:17-68:5 ([REDACTED]).

¹²² [REDACTED] Dep. Tr. 69:4-7. See also [REDACTED] Dep. Tr. 286:23-287:4 (“ [REDACTED] ”).

¹²³ [REDACTED].

¹²⁴ [REDACTED].

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market participants from an ability to trade anonymously on existing inter-dealer-broker central limit order books, such as ICAP.

160. A transition to anonymous all-to-all trade brings (i) greater pricing transparency, thus better pricing to the buy-side via knowledge of transactions prices and price quotes, (ii) heightened competition for trade demands, and thus better pricing, (iii) opportunities for buy-side investors to serve as providers of immediacy and not just consumers of immediacy from dealers, further increasing competition, and (iv) lower operational costs and faster execution.

161. Consistent with my opinion on the buy-side benefits of all-to-all trade, a 2012 presentation asks:

The presentation explains that

125

162. An internal 2014 presentation by of explains that, “

126 In

an email,

wrote: “

127

1. Reduced Trade Execution Costs

163. As I have stated, a migration to anonymous all-to-all trade reduces buy-side execution costs through (i) increased competition for each trade, (ii) better matching of ultimate buyers and sellers, (iii) heightened price transparency, and (iv) reduced information leakage of buy-side trading strategies.
164. Heightened competition arises from the greater number of quote providers competing for the opportunity to profit from intermediation, and results in tighter bid-offer spreads and lower price impact for larger orders.
165. With the advent of anonymous all-to-all trade, dealers’ costs for risk-managing their market-making positions would have declined because of their reduced costs for trading products available on anonymous all-to-all platforms populated by dealers and buy-side firms jointly competing to supply liquidity. Some of these dealer cost savings would have been passed on to buy-side firms in the form of more attractive price quotes, given that

125 [REDACTED].

126 [REDACTED], p. 3.

127 [REDACTED] ([REDACTED]).

dealers compete with each other (albeit imperfectly) for buy-side trades. This cost saving to dealers applies not only to the risk management of products traded on all-to-all platforms, but also to products not available on all-to-all platforms, because normal cost-efficient risk management strategies take advantage of the opportunity to hedge exposures to inactively traded products using positions in more actively traded products having approximately the same exposure to shifts in the term structure of interest rates.

166. All-to-all trade also increases the likelihood that a non-dealer who is anxious to buy has the opportunity to be matched directly on the trade platform with a non-dealer who is anxious to sell. In this event, there is no need to give a price concession to a provider of immediacy such as a dealer.
167. All-to-all trade platforms also increase price transparency, both through the publicly visible quotes on the order book and also from almost instantaneous and frequent post-trade publication of transaction prices. Equipped with this improved price transparency, buy-side firms can get better price terms by being in a better position to know when they are paying too much or receiving too little.
168. Anonymous all-to-all trade also reduces some of the costs to buy-side firms of information leakage arising from the disclosure of their identities to their dealer counterparties that would occur with bilateral and RFQ trade protocols. This information disclosure can worsen price terms on subsequent trades that are part of the same overall strategy or block execution plan. For example, the creation or liquidation of block-size positions is in many cases most efficiently “shredded” into a sequence of smaller orders that will follow over time. Once a dealer is aware of a specific buy-side firm’s likely trading intentions, that dealer is in a position to leak the information to other customers, or to use that information in the dealer’s own trading, which results in price “slippage” for the portion of the original buy-side trading interest that remains to be executed.
169. Large buy-side firms would have benefited from the option to execute some portions of their block-size orders on all-to-all platforms at more competitive price terms because they would have retained the option to execute some of their block-size trades (or some portions of these trades) using other trade protocols. That is, the but-for world that included anonymous all-to-all trade would have added beneficial options to trade on anonymous all-to-all trade platforms, and would not have removed useful options to trade on other venues.
170. Once trade on anonymous all-to-all platforms becomes sufficiently active, some block-size positions may be most efficiently executed entirely on all-to-all platforms by submission of a sequence of smaller orders over time¹²⁸ in a manner designed to take advantage of refreshment of the order book with new arriving limit orders, and to reduce the detection of a large latent trading interest.

¹²⁸ Kyle, Albert S., “Continuous Auctions and Insider Trading,” *Econometrica* vol. 53 (1985), pp. 1315-1336; and Almgren, Robert, and Neil Chriss, “Optimal Execution of Portfolio Transactions,” *Journal of Risk*, vol. 3 (2001), pp. 5-39.

- 133 [REDACTED], p. 14.

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- In a 2013 [REDACTED] internal email, [REDACTED] ([REDACTED]) wrote: “
[REDACTED]”¹³⁴
- A 2013 [REDACTED] presentation estimated the “[REDACTED]” The presentation stated that there would be “[REDACTED]”¹³⁵

2. Lower Costs for Exiting Dealer-Specific Swap Positions

175. In the case of an existing bilateral client-to-dealer derivatives position, the client can exit the position only by negotiating an offsetting trade with the original dealer. This provides the dealer with an exclusivity position that is common knowledge between the client and the dealer, and thus reduces the client’s bargaining position when negotiating the exit price. The client can alternatively hedge the market risk of the original bilateral position by entering a new opposite-direction swap that does not involve the original dealer, but this entails an effective doubling of counterparty risk, whereas an offset with the original dealer involves the elimination of the associated counterparty risk. This gives the original dealer an inherent bargaining advantage when negotiating the exit price terms. A centrally cleared swap, on the other hand, is fungible among all market participants who have access to the same central counterparty, so can be offset without incurring the additional costs associated with the exclusivity position of the original dealer. With the advent of active anonymous all-to-all trade, buy-side firms can thus benefit from this further advantage of substitution out of bilaterally negotiated swaps into similar swaps that are traded on an all-to-all venue.

3. Improved Price Transparency and Matching Efficiency

176. My research¹³⁶ with Piotr Dworczak and Haoxiang Zhu shows that better benchmark price transparency lowers buy-side trading costs and increases market efficiency and buy-side trade gains, through reduced dealer profit margins and, as a result, increased buy-side trade activity. Better price transparency also improves the efficiency of matching of buyers and sellers, by which those buyers having the most to gain from purchase are more likely to be matched with those sellers having the most to gain from sale.
177. A 2017 presentation prepared by [REDACTED] ([REDACTED]) explained: “[REDACTED]”
[REDACTED]

¹³⁴ [REDACTED].

¹³⁵ [REDACTED], p. 1.

¹³⁶ Duffie, Darrell, Piotr Dworczak, and Haoxiang Zhu, “Benchmarks in Search Markets,” *Journal of Finance*, vol. 72, no. 5 (2017), pp. 1983-2084.

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[REDACTED] 137

4. Lower Operational Costs and Access to Additional Trading Strategies

178. A 2012 report prepared by [REDACTED] explained [REDACTED]
[REDACTED]

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED] 138

179. [REDACTED] 139

5. Lower Risk of Loss of Liquidity

180. [REDACTED] 140

137 [REDACTED], at '367

138 [REDACTED], at '559-560.

139 [REDACTED], at '557.

140 See, for example, [REDACTED], at '418 ([REDACTED])
[REDACTED]

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- [REDACTED]
181. Such suggestions are internally inconsistent. Narrower bid-offer spreads are associated with higher liquidity, not lower liquidity. It is a natural outcome, as I have indicated, that lower dealer profit margins and a reduced dealer share of intermediation volumes could cause a significant reduction in aggregate dealer revenues. It is then possible, although not necessarily the case, that some dealers may be unable to overcome their operating and fixed costs, and could be forced to stop competing for liquidity provision. There would not be a market equilibrium, however, in which all dealers cease to provide market making services. As some less efficient dealers, those with the highest operating costs, drop out, the aggregate available market-making revenues available to dealers will then be shared among a smaller set of dealers, predominantly those with lower operating costs. As shown by Grossman and Miller in 1988, there would be an equilibrium number of dealers that actively make markets,¹⁴¹ supporting the continuation of liquidity provision in a world in which there is a migration of IRS trade to all-to-all venues. Moreover, while bid-ask spreads would indeed be compressed by a transition to anonymous all-to-all trade, in relative terms the equilibrium bid-ask spread is increasing, not decreasing as suggested, in the number of dealers exiting the market for immediacy provision. With anonymous all-to-all trade, non-dealers can supply substantial liquidity provision, offsetting the loss of liquidity provision associated with any departing dealers.
 182. As the Managed Funds Association has noted, “*Concerns that Dealers Will Provide Less Liquidity to Markets Without Post-Trade Name Disclosure Lack Precedent in Similar Markets*. In the transition to electronic trading of U.S. Treasuries on BrokerTec, the buy-side’s access to that anonymous trading platform did not result in sell-side dealers providing less liquidity to the market. On the contrary, BrokerTec has become a thriving market that facilitates the majority share of daily volume in electronically traded U.S. Treasuries in North America. In electronic order driven trading markets, it should not matter whether a dealer’s counterparty is another dealer or a buy-side firm. Thus, these markets should remain anonymous to create a level playing field for all participants. Further, as highlighted earlier, steps that promote impartial access to all SEFs encourage

squeeze margins and bid-ask spreads in many over-the-counter products.”); [REDACTED] ([REDACTED], dated July 26, 2013) ([REDACTED] noting

”); and

at ‘133 (October 2011

)([REDACTED]

”).

¹⁴¹ Grossman, Sanford and Merton Miller, “Liquidity and Market Structure,” *Journal of Finance*, vol. 43 (1988), pp. 617-633.

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alternative forms of price formation and liquidity provision and greater diversity of participation (among participants and modes of interaction)”¹⁴²

183. Research studies conducted at the Federal Reserve Bank of New York and at the Bank for International Settlements have found that electronification of various OTC financial markets, including BrokerTec trading of U.S. Treasuries, provides wider access to non-dealers such as principal trading firms (PTFs), and that this has maintained or actually improved market liquidity, despite reducing dealer profits.¹⁴³
184. A 2016 Barclays presentation at the European Central Bank also supports the view that PTFs are at least a partial substitute for dealers in the provision of liquidity on CLOBs, as dealers have stepped away from providing liquidity where new capital regulations have made the use of dealer balance sheets more costly.¹⁴⁴
185. Indeed, in markets that have made a transition to exchange trading, liquidity has generally been higher than in corresponding OTC markets.

, summarizes as follows: “

¹⁴² “Why Eliminating Post-Trade Name Disclosure Will Improve the Swaps Market,” *Managed Funds Association*, March 31, 2015, pp. 7-8, <https://www.managedfunds.org/wp-content/uploads/2015/04/MFA-Position-Paper-on-Post-Trade-Name-Disclosure-Final.pdf>. Citations omitted; italics in original.

¹⁴³ Adrian, Tobias, Michael Fleming, Or Shachar, and Erik Vogt, “Market Liquidity after the Financial Crisis,” Federal Reserve Bank of New York, Staff Report No. 796, October 2016, Revised June 2016, https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr796; Fleming, Michael J., Bruce Mizrach, and Giang Nguyen, “The Microstructure of a U.S. Treasury ECN: The BrokerTec Platform,” Federal Reserve Bank of New York Staff Reports, Staff Report No. 381 (July 2009; revised March 2017), https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr381.pdf?la=en; Bech, Morten, Anamaria Illes, Ulf Lewrick, and Andreas Schrimpf, “Hanging up the Phone – Electronic Trading in Fixed Income Markets and Its Implications,” *BIS Quarterly Review*, March 2016, pp. 79-94, https://www.bis.org/publ/qtrpdf/r_qt1603h.pdf.

¹⁴⁴ Lundstrom, Jan, “Bank Business Models and the Role of Principal Trading Firms (PTF) in Liquidity Provision and Intermediation,” Barclays, [https://www.ecb.europa.eu/paym/groups/pdf/bmcg/160407/2016-04-07_Item_3_bank_business_models_and_the_role_of_PTFs_in_liquidity_provision_and_intermediation.p](https://www.ecb.europa.eu/paym/groups/pdf/bmcg/160407/2016-04-07_Item_3_bank_business_models_and_the_role_of_PTFs_in_liquidity_provision_and_intermediation.pdf?dc289da65d86c27a14c20d5cce72effc)

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186. All members of the class would have benefited from the above-described reductions in trade costs, reduced operational costs, increases in price transparency, lower liquidity risks, and other benefits associated with a migration to anonymous all-to-all trading.

VI. ALL-TO-ALL ANONYMOUS TRADING WOULD HAVE HAD BENEFICIAL EFFECTS FOR ALL OR NEARLY ALL IRS PRODUCTS

A. All-to-All Anonymous Trading Would Have Quickly Had Beneficial Impacts for Buy-side Trade of All Benchmark IRS Products

187. Soon after the introduction of anonymous all-to-all trade platforms populated by some willing market makers, most trade in standardized benchmark IRS products would have quickly transitioned to these platforms. Buy-side investors in these products would then have benefited from greater price transparency, lower trade execution costs in terms of prices paid and received, lower ancillary trade and other operational costs, improved execution speed and convenience, and the other benefits that I have described, including the opportunity to profit by providing liquidity to other market participants.

188. A [REDACTED] slide deck [REDACTED]

146

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

¹⁴⁵ [REDACTED], at '239.

¹⁴⁶ [REDACTED], at p. 8.

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- [REDACTED]

B. All-to-All Anonymous Trading of Benchmark IRS Would Also Have Benefitted Trade of Less Actively Traded IRS Products

189. The beneficial impacts of all-to-all anonymous trading would not have been limited to highly standardized “benchmark” plain-vanilla fixed-floating IRS, such as 1-year, 2-year, 3-year, 5-year, 7-year, 10-year, and 30-year fixed-for-floating IRS. This is true for several reasons.
190. Once the most liquid benchmark IRS products had begun to be traded on anonymous all-to-all platforms, market participants would have begun trading other IRS products on such platforms as well.
- A November 2013 [REDACTED] presentation entitled “[REDACTED]” discusses [REDACTED]
147
 - A March 2012 [REDACTED] presentation entitled “[REDACTED]” stated: “[REDACTED]”
148
191. As I have stated, standardized IRS that are less actively traded can be viably traded on anonymous all-to-all trade platforms without necessarily using continuously operating CLOB protocols. Many less actively traded products can be traded via all-to-all RFQ or session-based batch double auctions. In these situations, buy-side market participants would not achieve some of the benefits of continuously operating CLOBs, such as continuous pre-trade price transparency and rapid order execution. Buy-side firms could nevertheless benefit from more episodic all-to-all trade through (i) anonymity, (ii) better prices through heightened competition for their trade demands, (iii) the opportunity to act as market makers, thus providing further competition for the provision of immediacy, and (iv) some of the operational benefits of all-to-trade such as straight-through processing into central counterparties.
192. In Section III.C of this report, I described how active exchange trade in benchmark financial products of a given type, such as equity options and Eurodollar interest-rate futures, creates a market environment in which less actively traded members of the same family of products will also become exchange listed, in order to garner some of the same benefits, including ease of access, cross-product hedging and speculation, and cross-product price transparency. Similarly, in the IRS market, all-to-all trade of IRS in benchmark maturities would have generated demand for all-to-all trade of standardized

147

[REDACTED], p. 3 ([REDACTED]).

148

[REDACTED], p. 4. Emphasis added with italics.

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but less actively traded IRS, including some standardized IRS with non-benchmark maturities. For example, statistics provided on the web site of the Federal Reserve Bank of New York show that, as of the end of 2016, about 7% of a sample of \$81 trillion dollar notional of US dollar IRS had maturities of greater than 14 years.¹⁴⁹ While this represents less active trade, one would expect that there would be, as the dealers themselves recognized, sufficient activity to support anonymous all-to-all trade of some off-benchmark-maturity IRS once trade in benchmark maturities has been increased by a transition to anonymous all-to-all trade.

193. This is a phenomenon that the Defendants recognize. By way of example, a November 2013 [REDACTED] slide deck entitled [REDACTED] discussed the

[REDACTED] ¹⁵⁰ In a July 2015 slide deck, [REDACTED] (

[REDACTED] noted that “

[REDACTED] and

[REDACTED] ¹⁵¹ [REDACTED]

194. [REDACTED] ([REDACTED])
testified: [REDACTED]

[REDACTED] ¹⁵² [REDACTED]

195. For trade in IRS products that are too customized or inactively traded to migrate onto anonymous all-to-all trade platforms, I have already described the benefits associated with improved price transparency and lower execution costs for related products that are traded on all-to-all venues. These benefits arise from a buy-side firm’s option to substitute with products that are available on all-to-all venues at lower execution costs, and from the improved price transparency for the less active product that is made available by immediate transactions prices reporting for related actively traded “all-to-all” products.
196. When a dealer’s client is immediately aware of the “going price” for an actively traded product on an anonymous all-to-all trade platform, the client is better able to judge the profit margin embedded in the dealer’s off-exchange price quotes. A dealer’s profit margin for bilateral or RFQ trades is thus disciplined not only by the client’s option to

¹⁴⁹ See Second Report, Alternative Reference Rates Committee, Sponsored by the Federal Reserve Board and the Federal Reserve Bank of New York, March 2018. Table 1, <https://www.newyorkfed.org/medialibrary/Microsites/arrc/files/2018/ARRC-Second-report>.

¹⁵⁰ [REDACTED], p. 2.

¹⁵¹ [REDACTED], p. 23.

¹⁵² [REDACTED] Dep. Tr. at 103:12-17.

substitute with the “exchange-traded version” of the product, but also from the improved price transparency associated with all-to-all trade. The resulting pricing benefit of benchmark pricing to a client is modeled in my earlier cited research with Dworczak and Zhu.¹⁵³

197. I will explain with a simple illustrative example based on a forward-starting interest-rate swap, which is a swap whose coupon payments begin at some future date. A forward starting swap, as distinct from a spot-starting swap, is used for applications in which a market participant is concerned with hedging or speculating on the term structure of interest rates that will apply at some future date. The majority of applications for IRS, such as the risk management of existing fixed-income products, are for spot-starting swaps. Hence, benchmark IRS are far more actively traded than forward-starting IRS. A forward starting swap is analogous, in terms of its risk characteristics, to futures on swaps,¹⁵⁴ which are also not as actively traded as benchmark IRS.
198. For instance, a “2y8y” forward swap is a swap whose payments begin in 2 years and continue for the next 8 years. This is not an actively traded product. Suppose, in a given market setting, that there is active all-to-all trade in benchmark interest-rate swaps with maturities at all years from 1 year to 10 years, but there is not enough trade activity in 2y-8y forward swaps to justify listing this forward-starting swap for all-to-all trade. Consider the position of a buy-side firm who would like to enter a 2y8y forward swap, as a payer of the fixed rate and receiver of the floating rate. The buy-side firm would have the option to negotiate a trade of this 2y8y forward swap bilaterally with a dealer, or could launch a request for quote if this product is available for trade on an RFQ platform. By reference to the frequently published prices of benchmark interest-rate derivatives traded on all-to-all trade platforms, the buy-side firm can make an accurate estimate of the “going fair price” for the 2y8y swap, or could quickly obtain a fair price estimate from a third-party information provider such as Bloomberg. A dealer providing quotes to the buy-side firm on the 2y8y swap, realizing that the buy-side firm would likely be aware of this fair price, would discipline its quotes accordingly or risk losing the opportunity to trade. If the dealer quotes are not sufficiently attractive relative to the estimated fair price, the buy-side firm could alternatively create a reasonable synthetic substitute with trades on the all-to-all venue, by obtaining a benchmark 10-year pay-fixed swap and a benchmark 2-year receive-fixed swap, both with low execution costs. This option to substitute also disciplines the dealer’s quotes unless the dealer is confident that the buy-side firm will not tolerate substitutions.
199. In general, improved price transparency in one set of financial products lowers dealer profit margins for the provision of related products whose fair market values can thus be more accurately ascertained.

¹⁵³ Duffie, Darrell, Piotr Dworczak, and Haoxiang Zhu, “Benchmarks in Search Markets,” *Journal of Finance*, vol. 72, no. 5 (2017), pp. 1983-2084.

¹⁵⁴ For example, CME offers a range of futures on swaps. Some of the key risk characteristics of a forward-starting swap can also be obtained synthetically with a strip of Eurodollar futures contracts.

C. All-to-All Anonymous Trading Would Also Have Benefitted Buy-side Trade in Forward Rate Agreements, Overnight Index Swaps, and Basis Swaps

200. The beneficial impacts of all-to-all anonymous trading would not have been limited to conventional fixed-for-floating interest rate swaps. Other OTC interest-rate derivatives, including some types of forward rate agreements (FRAs), overnight index swaps (OIS), and single-currency basis swaps, would have achieved sufficient standardization and trade activity for all-to-all anonymous trade. Assuming no interference from dealers, buy-side firms would have benefited in their trading of these three types of products, either from the migration of some trade in these products to anonymous all-to-all trade platforms, or from the availability of anonymous all-to-all trade in related interest-rate derivative products, thus providing improved substitution options and improved price transparency for the less actively traded products.

1. Forward Rate Agreements (FRAs)

201. A forward rate agreement (FRA) is an interest-rate derivative that promises a single fixed-for-floating coupon exchange at a future date. The contract is settled with a payment at the beginning of the future coupon period. FRAs are often used to manage interest rate risk.
202. FRAs were highly standardized long before 2010. As early as 1998, there were standardized terms for FRAs under conventions set up by ISDA and by the British Bankers Association.¹⁵⁵ By 2006, the market had converged to a standardized ISDA FRA contract type. Even as recently as 2017, the central clearing of FRAs by LCH was still based on the standard contractual definitions established by ISDA in 2000 and 2006.¹⁵⁶ LCH is the world's largest central counterparty for FRAs and other interest-rate derivatives.
203. FRAs were extremely actively traded by 2010. For example, according to the Triennial Survey of the Bank for International Settlements, the average daily turnover of FRA transactions in 2010 was \$600 billion notional, which was nearly half of the corresponding transactions volume of IRS transactions.¹⁵⁷
204. According to data provided by the Bank for International Settlements, in 2016 FRAs were even more frequently cleared in central counterparties than IRS.¹⁵⁸

¹⁵⁵ See "The use of forward rate agreements in Canada," Bank of Canada Review, Spring, 1998, <https://www.bankofcanada.ca/wp-content/uploads/2010/06/r982d.pdf>.

¹⁵⁶ LCH, "FCM Product Specific Contract Terms and Eligibility Criteria Manual," December 2017, https://www.lch.com/system/files/media_root/fcm-product-specific-manual-sr9-12.4.17.pdf.

¹⁵⁷ See BIS Triennial Survey <https://www.bis.org/publ/rpfx16ir.pdf>, p. 8.

¹⁵⁸ See Woolridge, Philip, "Central clearing predominates in OTC interest rate derivatives markets," *BIS Quarterly Review*, December 2016, pp. 22-24. "In the OTC interest rate derivatives market, the share of notional amounts booked against CCPs was highest for forward rate agreements, at 91% at end-June 2016 (Graph A2, left-hand panel). This is equivalent to a clearing rate of at least 84%, although this is probably

205. Buy-side firms were active users of FRAs. According to the Bank for International Settlements, of total transactions volumes in 2010 of FRA transactions, approximately 50% was with non-dealers, comprised of 44% with non-dealer financial institutions and 6% with non-financial customers of dealers.¹⁵⁹ Commercial banks use FRAs heavily, and would have been an important subset of the non-dealers benefiting from anonymous all-to-all trade of FRAs.
206. Since the 1990s, the CME has offered active trade in Eurodollar futures, whose risk characteristics are similar to those of US dollar FRAs with 3-month coupon periods. Consistent with the buy-side benefits of anonymous all-to-all trade that I have stated, volumes of trade in Eurodollar futures are extremely high, as shown in the figure in Section III of my report.
207. Putting aside technical settlement details, FRAs are effectively single-coupon forward-starting fixed-for-floating IRS. As such, the pricing of FRAs is closely structurally related to the term structure of IRS rates. The pricing of FRAs with longer maturity dates is therefore made more transparent by increasing the price transparency of fixed-for-floating swaps. Thus, buy-side firms that trade FRAs would have benefited from the advent of anonymous all-to-all trade in fixed-for-floating interest rate swaps, including from the immediate dissemination of IRS transaction prices. There is also a buy-side benefit from anonymous all-to-all trade of IRS and FRAs through the improved ability to execute cross-product trading strategies that take advantage of the close structural relationship between FRAs and fixed-for-floating swaps.

2. Overnight Index Swaps (OIS)

208. An overnight index swap (OIS) is an interest-rate derivative that, at maturity, exchanges the notional size of the swap multiplied by the difference between a fixed interest rate and a floating interest rate index. The floating rate index is obtained by compounding a benchmark overnight interest rate from the inception of the swap to its maturity. In US dollars, the most common underlying overnight interest rate is the Effective Federal Funds Rate, the main policy rate of the U.S. Federal Reserve System (“the Fed”). In Euros, the most common underlying overnight rate is Eonia.
209. Buy-side firms use OIS for applications that include speculation and risk management, with respect to the uncertain future path of overnight interest rates. For example, a speculator may have a view on upcoming decisions by the Fed to re-target the Effective Federal Funds Rate. Among a host of other buy-side applications described in 2001 by Credit Suisse, “OIS allow banks to manage their liquidity requirements more effectively. Term deposits may be raised at effectively floating overnight rates, improving liquidity ratios but without locking in the term interest rate.”¹⁶⁰ In this context, “banks” does not

an underestimate. For interest rate swaps, the share booked against CCPs was 80%, which is equivalent to an estimated minimum clearing rate of 66%.” https://www.bis.org/publ/qtrpdf/r_qt1612r.htm.

¹⁵⁹ See BIS Triennial Survey <https://www.bis.org/publ/rpfx16ir.pdf>, p. 9.

¹⁶⁰ Credit Suisse, “Overnight Index Swaps,” December 11, 2001, http://janroman.dhis.org/finance/OIS/OIS_Note_CSFB_Zurich.pdf.

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refer to dealers, but rather to non-dealer commercial banks. According to the same 2001 Credit Suisse publication, “Since their introduction in the 1990s, Overnight Indexed Swaps have become a widely-used, highly credit-efficient and liquid derivative in all major currencies. They are used to hedge against, or speculate on, moves in overnight interest rates (both ‘micro’ moves—daily volatility—and, more importantly, ‘macro’ moves driven by central banks, who influence overnight rates directly).”¹⁶¹

210. OIS are also used by dealers to manage the risks associated with changes in the market values of their inventories of swaps and other financial products.¹⁶²
211. As with FRAs, the OIS market was highly standardized by ISDA long before 2010.¹⁶³ By 2010, volumes of trade were high. For example, a study by economists at the Federal Reserve Bank of New York showed that, for a large representative sample of trades conducted in mid-2010, daily average notional OIS trade volumes were about the same or a bit higher than corresponding IRS volumes, although the number of OIS transactions was only about 10% of the number of IRS transactions.¹⁶⁴
212. LCH began the central clearing of OIS in July 2009, initially in four currencies—dollars, sterling, euro, and Swiss francs—and with maturities of up to two years.¹⁶⁵ An internal 2010 [REDACTED] presentation discussed [REDACTED]¹⁶⁶

¹⁶¹ Credit Suisse, “Overnight Index Swaps,” December 11, 2001, http://janroman.dhis.org/finance/OIS/OIS_Note_CSFB_Zurich.pdf.

¹⁶² On June 29, 2010, LCH began using the OIS swap curve to discount its SwapClear portfolio, switching from LIBOR. “[A]n increasing proportion of trades are now priced using OIS discounting. After consultation with market participants, the clearing house has decided to move to OIS to ensure the most accurate valuation of its portfolio for risk management purposes.” LCH CEO, Roger Liddell said “Accurate pricing is essential for prudent risk management. With the market moving increasingly to OIS, it was important for us to consider the implications of this. Our move to OIS discounting demonstrates our commitment to the highest standards of risk management.” “OIS on the Rise in Swap Market, but not yet in Futures,” *Future & Options Intelligence*, Issue 1525, June 18, 2010.

¹⁶³ See LCH, “FCM Product Specific Contract Terms and Eligibility Criteria Manual,” December 2017, https://www.lch.com/system/files/media_root/fcm-product-specific-manual-sr9-12.4.17.pdf.

¹⁶⁴ Fleming, Michael, John Jackson, Ada Li, Asani Sarkar, and Patricia Zobel, “An Analysis of OTC Interest Rate Derivative Transactions: Implications for Public Reporting,” Federal Reserve Bank of New York Staff Reports, Staff Report No. 557 (March 2012; revised October 2012), https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr557.pdf.

¹⁶⁵ “SwapClear to Clear Overnight Index Swaps,” *Future & Options Intelligence*, Issue 1429, July 16, 2009.

¹⁶⁶ [REDACTED], at slide 91. In this June 2010 presentation entitled “[REDACTED]” states: “[REDACTED]”

3. Single-Currency Basis Swaps

213. A single-currency (or “same-currency”) basis swap, often simply called a “basis swap,” is an interest rate swap that exchanges one floating interest rate for another floating interest rate in the same currency. Basis swaps are used mainly to manage interest rate risk, for instance by commercial banks, and can also be used to speculate on the relative movements of two different floating interest rates.
214. In the study by the Federal Reserve Bank of New York that I have already cited, basis swaps ranked fifth of eight classes of OTC interest-rate derivatives in both transactions frequency and dollar volume.¹⁶⁷ In the mid-2010 transactions data used in this study, basis swaps represented about 15% of trade in IRS in terms of notional trade volume and 2.5% in terms of number of transactions.
215. The central clearing of basis swaps was available at LCH by 2011.¹⁶⁸

4. Viability of Anonymous All-to-All Trade of FRAs, OIS, and Basis Swaps

216. On average, FRAs, OIS, and basis swaps are not as actively traded as conventional fixed-for-floating IRS. Assuming no interference from dealers, active anonymous all-to-all CLOB trade of some types of these three product classes would have occurred, but would have been less prevalent than for fixed-for-floating IRS. Trade in some types of these three product classes would have been viable using other forms of anonymous all-to-all protocols, such as all-to-all RFQ and sessions-based double auctions. Some less actively traded types of these three product classes would not have traded at all on anonymous all-to-all venues. In all cases, however, buy-side trading of these three product classes would have benefited from the emergence of anonymous all-to-all trade of some of the more actively traded types of these three product classes, as well as IRS. Buy-side firms would have received better prices for FRAs, OIS, and basis swaps, even for types of products that were not available for trade on anonymous all-to-all platforms, through the option to substitute with products available on anonymous all-to-all platforms and from the improved price transparency associated with immediate transaction reporting from benchmark products traded on anonymous all-to-all platforms.
217. All or nearly all members of the buy-side class, to the extent that they traded these three product classes, would have benefited from the ability to participate in anonymous all-to-

Products expected to include vanilla IRS, Swaptions, OIS, FRAs (note LCH currently clears Swaps, OIS, with FRAs due early 2011; swaptions will follow).”

¹⁶⁷ Fleming, Michael, John Jackson, Ada Li, Asani Sarkar, and Patricia Zobel, “An Analysis of OTC Interest Rate Derivative Transactions: Implications for Public Reporting,” Federal Reserve Bank of New York Staff Reports, Staff Report No. 557 (March 2012; revised October 2012), https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr557.pdf.

¹⁶⁸ LCH.Clearnet Annual Report & Accounts 2011, https://www.lch.com/system/files/media_root/Annual%20Reports/LCH.Clearnet%20Annual%20Report%20and%20Accounts%202011.pdf.

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all trade of benchmark FRAs, OIS, and basis swaps, for precisely the same reasons that I have provided for the buy-side benefits of anonymous all-to-all trade of IRS, including better price terms through more competitive pricing and improved price transparency, lower operational costs, speedier execution, and the opportunity to act as market makers, thus creating more competition for the provision of immediacy. Again with these three product categories, dealers would have had reduced profit margins from heightened competition, and would have suffered from disintermediation. The principles at play here are generally the same as those for IRS.

218. CLOB trade of benchmark FRAs, OIS, and basis swaps was supported on inter-dealer broker platforms such as those of ICAP, Tullett Prebon, BGC, Tradition, and Tradeweb. In a presentation dated June 5, 2014,

¹⁶⁹ [REDACTED]
¹⁷⁰ By mid-2014,
¹⁷¹ On their websites today, each of these platform operators indicate that they provide CLOB trading of OIS and basis swaps, with some also providing CLOB trading of FRAs.¹⁷² Data produced in this case show that basis swaps and OIS were traded via Dealerweb's CLOBs.¹⁷³

¹⁶⁹ [REDACTED], at slide 19: [REDACTED] (6/5/2014 parent email from [REDACTED] at [REDACTED], stating: "[REDACTED]").

¹⁷⁰ [REDACTED], at slide 19: [REDACTED] ([REDACTED]); [REDACTED] ([REDACTED] at slides 2 and 3) (April 14 [REDACTED] " showing that "[REDACTED]"; and [REDACTED], at slide 12 ([REDACTED]) (" [REDACTED] ").

¹⁷¹ [REDACTED], at slide 19 [REDACTED] (12/21/2016 email from [REDACTED] at [REDACTED] to [REDACTED] at [REDACTED] showing [REDACTED]); and [REDACTED] at [REDACTED], '7835 ([REDACTED]) (6/10/2015 email from [REDACTED] at [REDACTED] to [REDACTED] at [REDACTED] explaining "[REDACTED] ").

¹⁷² See "Products and Services: IRS Overview," Tradition SEF, <http://www.traditionsef.com/markets/irs/> ("Trad-X facilitates both hybrid and fully-electronic order entry, allowing users to execute the most complex of trading strategies via voice instruction, direct click-and-trade central limit order book access, and auction services. It covers a broad range of products across USD, EUR and GBP currencies, including interest rate swaps, FRAs, overnight index swaps, and single and cross-currency basis swaps."); "Overnight Index Swaps," ICAP, <https://www.icap.com/what-we-do/our-markets-and-products/products/overnight-index-swaps.aspx?frommobile=true> ("The i-Swap electronic platform operates a regulated Multilateral Trading Facility (MTF) for euro denominated overnight index swaps. The platform supports both Central Limit Order Book (CLOB) and Targeted Streaming (TS) markets with full trading functionality available to all market users. Its hybrid CLOB and pure electronic TS markets ensure leading liquidity, execution and transparency, and combine the best of voice and

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219. In [REDACTED] October 2013 [REDACTED]
[REDACTED]¹⁷⁴

Although Tradeweb later withdrew its MAT determination for OIS and basis swaps,¹⁷⁵ I do not consider that withdrawal by Tradeweb to be determinative of the economic viability of anonymous all-to-all trade or of the benefits to buy-side firms of access to anonymous all-to-all trade. The Defendant dealers had substantial governance rights at Tradeweb. The Defendant dealers would not have benefited from the advent of anonymous all-to-all trade of these products, for the reasons that I have described.

220. Bloomberg's December 2013 submission letter to the CFTC¹⁷⁶ concerning MAT determinations recommended against MAT for OIS and basis swaps, citing the low quantity of transactions in these products handled by Bloomberg's SEF. As I have emphasized, transactions volumes can be increased significantly by offering anonymous all-to-all trade.¹⁷⁷

221. Consistent with my opinions, The Managed Funds Association (MFA), in a letter to the CFTC dated November 21, 2013, supported a phased implementation of made-available-to-trade determinations for a number of types of swaps, including basis swaps, OIS, and FRAs,¹⁷⁸ on trueEX, Tradeweb, and Javelin. The MFA recommended a phased introduction of various classes of interest-rate derivatives, beginning with benchmark IRS and going to successively less liquid classes. The MFA recommended 90-day time delays

electronic markets."); "tpSEF: Swap Execution Facility (SEF)," tullett prebon, <https://www.tullettprebon.com/swap-execution-facility> ("A central limit order book is available for all products listed for trading by tpSEF.").

¹⁷³ [REDACTED], received on August 8, 2018.

¹⁷⁴ See [REDACTED] at '472 ([REDACTED]) and at '473 [REDACTED].

¹⁷⁵ Letter to Melissa Jurgens (CFTC, Secretary) from Lee H. Olesky (Tradeweb, CEO) and Douglas Friedman (Tradeweb, General Counsel), November 29, 2013, Re: TW SEF LLC – Clarification and Amendment to Self-Certification for Swaps to be Made Available to Trade, <https://www.cftc.gov/sites/default/files/stellent/groups/public/@otherif/documents/ifdocs/twsefamendmatltr112913.pdf>.

¹⁷⁶ Letter to Melissa Jurgens (CFTC, Secretary) from Gregory Dumark (Bloomberg SEF LLC, Chief Compliance Officer), December 5, 2013, Re: Bloomberg SEF LLC – Made Available to Trade ("MAT") Submission of Certain Credit Default Swaps ("CDS") and Interest Rate Swaps ("IRS") pursuant to Commodity Futures Trading Commission (the "Commission") Regulation 40.6 (submission #2013- R-9). <https://www.cftc.gov/sites/default/files/stellent/groups/public/@otherif/documents/ifdocs/bsefmatdetermltr120513.pdf>.

¹⁷⁷ I am puzzled by Bloomberg's decision not to recommend MAT for OIS and basis swaps.

¹⁷⁸ [REDACTED], at '777.

between successive classes of derivatives, in order to allow time to achieve liquid trade in class, in preparedness for the support of viable trade in each successively less liquid class. The second phase, 90 days after benchmark IRS, included basis swaps and OIS at benchmark tenors, in US dollars and euros. The third phase, another 90 days later, would include additional types of OIS and basis swaps. The fourth phase would include FRAs and additional OIS and basis swaps. In my opinion, as stated previously in this report, the advent of anonymous all-to-all trade of benchmark IRS would have quickly increased market depth and volumes of trade substantially, as more and more trade migrated into this trade protocol, to a point at which anonymous all-to-all trade of less actively traded related products becomes viable.

D. Buy-side Costs for Block Trades Would Have Been Reduced by the Existence of All-to-All Anonymous Trading Platforms

222. Large trades—colloquially known as “block trades”—also would have benefited from all-to-all trade, even if some block trades, or some portions of the desired block-sized trade demands, are not executed on an all-to-all trade platform.
223. The “price impact” of a trade is the portion of the price concession that is associated with the size of the trade. For example, suppose for a given financial product that a typical trade size can be executed at a price concession of 1 basis point (0.01%) of the notional size, representing about half of the bid-offer spread. Suppose that in order to execute a much larger trade size in the same instrument, an investor must suffer a larger price concession of 1.5 basis points of the notional size. The associated price impact, the component of the execution cost associated with the larger size of the trade, is then 0.5 basis points. A larger trade typically has a higher price impact, whether executed bilaterally, by RFQ, or on an all-to-all platform. In all three cases, providers of immediacy require a greater price concession for absorbing a larger sized trade. This is so because they must commit more capital and take more risk into their own portfolios. Price impacts can also arise because providers of immediacy are often concerned that a large trade demand signals that the counterparty may have private information about likely future price changes. A larger sell order, for example, may convey a more negative signal about the future trajectory of prices.
224. The total price impact for a large trade can often be minimized by splitting the order across time and across trade venues, so as to lessen the average price concession. For example, an investor might execute some of a large swap trade on an all-to-all platform, taking advantage of lower expected execution costs for at least some fraction of the desired trade size. The remainder of the total trade could be executed bilaterally or by RFQ. In this manner, the investor can obtain a lower expected total execution cost than would be the case for a market without all-to-all trade. For this reason, the CFTC provided regulatory exemptions to SEF trading requirements for sufficiently large block trades.
225. If all-to-all trade exists, dealers providing immediacy for a block-size trade in a bilateral or RFQ protocol are aware that if they do not quote sufficiently attractive prices to their client, the client can react by executing a larger fraction of the total position on the all-to-

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all platform. In this way, common knowledge between the client and the dealer of the client's option to make greater use of all-to-all trade leads to better all-in price terms for the client.

226. The fact that certain trades (including block trades) are executed off-SEF does not necessarily imply that these trades are unsuited to all-to-all anonymous trade. Rather, some of these trades may be executed off-SEF because dealers are protecting their revenues. For example, an August 2010 [REDACTED] " [REDACTED]" presentation¹⁷⁹ shows [REDACTED]

[REDACTED]¹⁸⁰

VII. CONCLUDING REMARKS

227. By around 2005, the trading of benchmark interest-rate swaps became suitable for a migration to anonymous all-to-all trade protocols. Since that time, market conditions supporting the viability of anonymous all-to-trade in this sector of the derivatives market have only become more and more compelling, especially because of increasing trade volumes, the increasing range of products becoming standardized and accessible to central clearing, and the increasing number of trade platform operators that offered central limit order book facilities and other protocols suitable for anonymous all-to-all trade of benchmark IRS, FRAs, OIS, and single-currency basis swaps. At the latest, this migration should have begun by 2010. Yet this transition to anonymous all-to-all trade never occurred, even to this day, despite the additional impetus of post-crisis regulatory reforms implementing Title VII of the Dodd-Frank Act.
228. Assuming no dealer-created obstacles, a large fraction of trading in OTC interest rate derivatives could have made a rapid transition to anonymous all-to-all trade, beginning with the most actively traded benchmark interest rate swaps. Anonymous all-to-all trade would have become active on existing inter-dealer broker CLOB platforms. There would have been active trade on trade platforms such as those operated by Bloomberg, trueEX, Tera, and Javelin, that set up facilities for anonymous all-to-all trade facilities of benchmark products, including fixed-floating IRS, FRAs, OIS, and basis swaps. If acting in their individual interests, some dealers would have responded to their profit incentives by offering meaningful market-making services on anonymous all-to-all platforms. Once anonymous all-to-all trade platforms had begun to handle a non-trivial fraction of trade volume of a benchmark product, the majority of trade volume in that product would, one would expect, have made the transition to anonymous all-to-all trade within months.

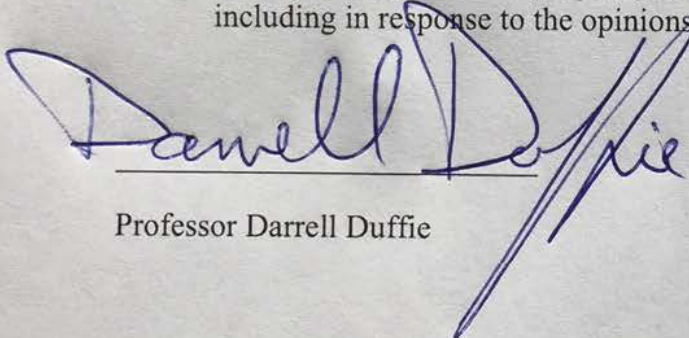
¹⁷⁹ [REDACTED], at '503.

¹⁸⁰ [REDACTED], at '503.

229. With the emergence of anonymous all-to-all trade, the price terms of trade offered to buy-side firms would have improved substantially, mainly through the increase in competition among dealers and non-dealers to provide quotes. Trade volumes, market depth, and the breadth of participation in trade would have increased. New buy-side firms would have entered the IRS market, given the lower trading costs associated with improved buy-side price terms, increased price transparency, reduced dealer costs for risk-managing their market making inventories, and reduced operational complexity, delays, and costs. New forms of trading strategies, such as high-frequency strategies, would have become feasible. Non-dealers would have had the opportunity to provide liquidity to other market participants. The market would have become more efficient, transparent, and stable.
230. These reductions in the cost of trading products available on anonymous all-to-all platforms would have had a reinforcing feedback effect on themselves, as more and more trade migrated onto these platforms and as new sources of trade appeared, taking advantage of the lower costs and heightened functionality and speed of trade, thus further lowering trading costs, and so on, in a virtuous loop. The migration of trade in equity options from the bilateral OTC dealer-intermediated market onto the anonymous all-to-all platform set up in 1973 by Chicago Board Options Exchange is a reasonable case example.
231. The fraction of trade intermediated by dealers and average dealer profit margins on each trade would both have declined significantly.
232. The initial migration of trade in benchmark IRS to anonymous all-to-all platforms would have caused other OTC interest-rate derivatives to become suitable for anonymous all-to-all trade. Increased IRS trade volumes and price transparency, and the potential for cross-product trading strategies enabled by CLOB functionality, would have caused a migration to all-to-all venues of additional types of IRS and of the most actively traded types of FRAs, OIS, and single-currency basis swaps.
233. Some trading in less standard or less actively traded fixed-floating IRS, FRAs, OIS, and basis swaps would have been substituted with trades in products available on anonymous all-to-all platforms, given the many associated buy-side benefits that I have described. For the remaining trade in less standard or less actively traded products, and also for block trades of standardized interest-rate derivatives that are conducted away from all-to-all venues, the price terms of trade offered by dealers to buy-side firms would have been more competitive, and thus more advantageous to the buy-side, because of the heightened price transparency available to the buy-side for related products available on all-to-all trade venues, and because of the discipline on dealer's price quotes associated with the recognition that buy-side firms could, if offered sufficiently unattractive prices, substitute with standard products available on all-to-all platforms. Dealers would have also passed on to buy-side firms, in the form of better prices, some of their cost savings associated with the ability to efficiently hedge their market making inventories of less standard or less actively traded products, and their block-sized market-making positions, with trading strategies involving benchmark products on anonymous all-to-all platforms.

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234. All or nearly all buy-side firms would have benefited from the emergence by 2010 or earlier of viable anonymous all-to-all trade. All market participants would have received more competitive price terms, thus lower execution costs, for trades that they chose to make on anonymous all-to-all platforms, due to the associated increases in price transparency and competition for their orders. Many buy-side firms would also have benefited from their ability to provide liquidity to other firms trading on these platforms. No buy-side firms would have been harmed by the existence of this option to act as a provider of liquidity to others. All firms trading on these platforms would have benefited from reduced operational complexity and costs, and reduced trade delays associated with higher trade volumes and faster trade execution methods.
235. Large buy-side firms would have benefited from the option to execute some portions of their block-size orders on all-to-all platforms at more competitive price terms. They would have retained the option to execute some of their block-size trades (or some portions of these trades) using other trade protocols, such as bilateral and RFQ. For block-sized trades obtained away from all-to-all platforms, large buy-side firms would also benefit from better dealer price quotes, given the common knowledge that they could substitute with trades on all-to-all platforms. No buy-side firm would have been worse off from having the additional option to conduct some of its trades on anonymous all-to-all platforms, even if they chose not to do so (despite the advantages of doing so).
236. My research into the matters discussed in this report is ongoing, and I reserve the right to modify or supplement my opinions as additional information becomes available, including in response to the opinions of any experts retained by Defendants.

A handwritten signature in blue ink that reads "Darrell Duffie". The signature is stylized with a large, sweeping "D" and a long, horizontal stroke extending to the right.

Professor Darrell Duffie

February 20, 2019

Date

Appendix A

Curriculum Vitae of DARRELL DUFFIE

Contact:

email: duffie@stanford.edu
personal webpage: darrellduffie.com

Postal Address:

Graduate School of Business
655 Knight Way
Stanford University
Stanford CA 94305-7298

UNIVERSITY
EDUCATION

Stanford University, Ph. D. (Engineering Economic Systems) (1984)

University of New England (Australia), Master of Economics (Economic Statistics) (1980)

University of New Brunswick (Canada), Bachelors of Science in Engineering (Civil Engineering) (1975)

AWARDS
AND
HONORS

1985-86 NSF Research Fellowship
1988-89 Batterymarch Fellowship
1990-92 NSF Research Grant
1992-93 Catalyst Institute Research Grant
1994-95 Q Group Research Award
1994-96 NSF Research Grant
Fellow, Econometric Society
1997 Smith-Breeden Distinguished Paper Prize, *Journal of Finance*
2001 Graham and Dodd Award, *Financial Analysts Journal*
2002 NYSE Prize for equity research, Western Finance Association
2003 Distinguished teacher award, Doctoral Program, Graduate School of Business, Stanford University
2003 Financial Engineer of the Year, International Association of Financial Engineering
2004 Clarendon Lectures in Finance, Oxford University.
2007 Princeton Lectures in Finance.
2007 Elected Fellow of the American Academy of Arts and Sciences.
2008 2011, Elected to the Council of the Econometric Society.
2008 Nash Lecture, Carnegie-Mellon University.
2009 Elected President of the American Finance Association.
2010 Tinbergen Institute Finance Lectures, Duisenberg Institute.
2011 Minerva Foundation Lectures, Columbia University.
2015 Ross Prize, FARFE (with Jun Pan and Ken Singleton).
2015 Fisher-Shultz Lecture, World Congress, Econometric Society.
2016 AQR Prize (with Haoxiang Zhu).
2017 Baffi Lecture, Banca d'Italia.
2018 Amundi Smith Breeden Prize, best paper, Journal of Finance.

EMPLOYMENT

1984-present: Graduate School of Business, Stanford University
Current Position: Dean Witter Distinguished Professor of Finance
On leave: Mathematical Sciences Research Institute, University of California, Berkeley, 1985-1986; Université de Paris, Dauphine, 1998; University of Lausanne, 2007-2008; EPFL, 2015-2016.

- RESEARCH INTERESTS securities markets; derivatives; financial risk management; asset pricing theory; preferences under uncertainty, financial market innovation and security design; interest-rate modeling and fixed-income security pricing; over-the-counter markets; financial market infrastructure, central banking, market design.
- BOOKS *Security Markets: Stochastic Models*, Boston: Academic Press, 1988.
- Futures Markets*, Englewood Cliffs, New Jersey: Prentice-Hall, 1989. Japanese translation, Kinzai Publishing Company, 1994; Chinese translation, 1996.
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Economic Theory, December, 1989 to February, 1996.

Journal of Economic Theory, 1986 to 1999.

Mathematical Finance, October, 1989 to January, 2001.

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Asia Pacific Financial Markets, August 1993 to 2006.

The Review of Derivatives Research, December, 1993 to 2007.

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Journal of Computational Finance, February, 1997 to 2017.

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Quantitative Finance. July 2015 to present.

PROFESSIONAL

Council, Bachelier Society, 1996 to 1999.

International Association of Financial Engineers, Governing Board (1997 to 2000), Senior Fellow from 2005.

SERVICE

External Advisory Board, Institute for Computational Finance, University of Texas, Austin, 1996 to 2005.

International Advisory Board, Centre for Financial Engineering, National University of Singapore.

Econometric Society, Fellow, Member of Council (2009-2012), Investments Committee (2009-2016).

National Bureau of Economic Research, Research Associate.

NCCR FinRisk, International Scientific Council, Switzerland; 2005-2012.

Organizing Committee, Quantitative Developments in Finance, Newton Institute, Cambridge University, 2005.

American Finance Association, Executive Committee, 2007-2011; Vice-President, 2007-2008; President-Elect, 2008-2009; President, 2009-2010; Board of Directors, 2000-2003, 2007-2011.

	<p>Banff International Research Station, Scientific Advisory Board, 2005 to 2010.</p> <p>The Chicago Mercantile Exchange-Mathematical Sciences Research Institute Prize Committee, 2005 to 2011.</p> <p>The Federal Reserve Bank of New York, Financial Advisory Roundtable, 2006 to 2016.</p> <p>Financial Economists Roundtable, 2007 to 2015.</p> <p>Pacific Institute of Mathematical Sciences, Board of Directors, 2007 to 2018.</p> <p>Stanford University, Working Group on Global Markets, Member, 2008 to present.</p> <p>Squam Lake Working Group, Member.</p> <p>Stanford Institute of Economic Policy Research (SIEPR), Senior Fellow, 2009 to present.</p> <p>Society of Financial Econometrics (SoFiE), Council, 2009 to 2017.</p> <p>Swiss Finance Institute, Scientific Council, 2010 to present.</p> <p>Duisenberg Institute, Scientific Council, 2010 to 2015.</p> <p>Initiative on Global Markets (IGM), University of Chicago, Experts Panel, 2010-present.</p> <p>Stanford University, Financial Institutions Resolution Group, 2009-present.</p> <p>SWIFT Institute Advisory Council, 2012-2016.</p> <p>American Academy of Arts and Sciences, Fellow. 2010-present.</p> <p>Asian Bureau of Finance and Economics Research, Senior Academic Fellow.</p> <p>Bureau of Finance and Economics Research, Senior Academic Fellow.</p> <p>Member, World Economic Forum Global Agenda Council on the Global Financial System (2010-2017).</p> <p>World Economic Forum, The Role of Financial Services in Society, Steering Committee (2010-2017).</p> <p>Market Participants Group on Reference Rate Reform, 2014-2017 (chair).</p> <p>P.R.I.M.E. Finance Foundation, Panel of Recognized International Market Experts in Finance, 2014-present.</p> <p>Institute for Global Finance, University of New South Wales, Senior Fellow, 2014-present.</p> <p>Vox China, Advisory Board, 2016-present.</p> <p>Risk Advisory Council, Global Risk Institute, Canada, 2014-present.</p>
CORPORATE BOARDS	<p>iShares Funds and Trusts, San Francisco, 2008-2011.</p> <p>Moody's Corporation, New York, 2008-2018.</p> <p>TNB Inc., Connecticut, 2018-present.</p>
OTHER	<p>Bank One and I.R.S., Chicago (expert testimony, valuation of swaps).</p> <p>Board of Directors, Affinium Fund, London.</p>
COMPENSATED	<p>International Monetary Fund, Washington, D.C. (credit risk).</p> <p>Citigroup, New York (economic capital).</p>
ACTIVITIES	<p>Merrill Lynch, New York (risk management).</p> <p>Paloma Partners, Greenwich CT (risk management).</p>
2003-2018	<p>Ixis, Paris (credit markets).</p> <p>Schering-Plough, Kenilworth NJ (asset valuation).</p> <p>MBIA, New York (credit risk management).</p> <p>Bombardier, Toronto (corporate debt valuation).</p> <p>Moody's, Academic Research and Advisory Committee, New York.</p> <p>Credit Suisse, New York (financial markets and risk management), New York.</p>

Quinn Emanuel, New York, (consulting and expert witness testimony, credit risk corporate debt valuation, credit derivatives, interest-rate swaps).
 New York State Tax Authority (repurchase agreements), New York.
 Cantor Fitzgerald (inter-dealer broker markets), New York.
 Independent Health Care Trusts for UAW Retirees of General Motors Corporation and of Ford Motor Corporation, (exercise of equity options), Detroit.
 State Street Bank (speech to investor conference), Boston.
 PayNet Inc. (estimation of default probabilities), Chicago.
 Matterhorn Investment Management (global capital markets), London.
 Cantor Fitzgerald (interdealer brokerage of treasuries), New York.
 Public Prosecutor of Milan (valuation of swap agreements), Milan Italy.
 Federal Reserve Bank of Chicago (central clearing counterparties), Chicago.
 Kepos Capital (academic advisory board), New York.
 Lehman Estate (consultation on bankruptcy-related issues), New York.
 Incisive Media (public speaking).
 Rothwell, Figg, Ernst & Manbeck (consultation on intellectual property rights), Washington DC,
 Sansome Capital (consultation on global capital markets), San Francisco.
 Och-Ziff Management LP (consultation on hedge fund risk management), New York.
 Government of Canada, Department of Justice (Capital Markets Stability Act), Ottawa.
 Zurich Financial Services (economic risk), Zurich.
 Municipal Securities Rulemaking Board (financial benchmarks), Washington DC.
 Banque Lombard Odier (asset management), Geneva.

This curriculum vitae is current as of December, 2018.

**APPENDIX B
DOCUMENTS RELIED UPON**

CASE FILINGS

Second Consolidated Amended Class Action Complaint, Dkt. 142
Order Regarding Class Plaintiffs' Motion for Clarification, Dkt. 251
Opinion and Order Granting in Part and Denying in Part Defendants' Motion to Dismiss, Dkt. 237
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DOCUMENTS PRODUCED IN DISCOVERY¹

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¹ For convenience, only the first bates number in a multi-page document is listed.

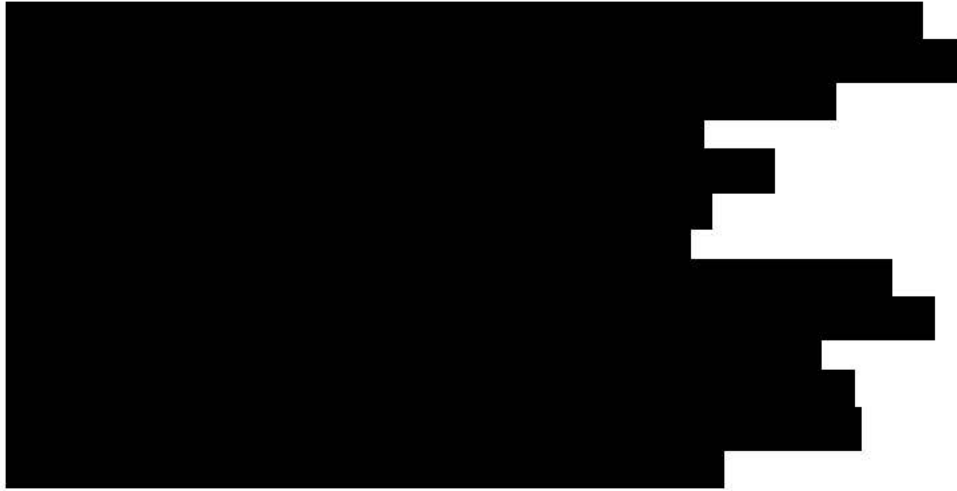
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